Welch Allyn

Service Manual

Welch Allyn
Vital Signs Monitor

Medical Division
4341 State Street Road, P.O. Box 220
Skaneateles Falls, NY 13153-0220

PN 95P360E
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SECTION 1:

General Information

SERVICE MANUAL

Welch Allyn

Vital Signs Monitor

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Welch Allyn Co.

4341 State Street Road
Skaneateles Falls, NY 13153-0220

Service Manual pn95P360E
Rev. 4, 9/98

*Note: All drawings enclosed are for reference only. Consult the system or the factory for all current drawings.

Revision History

Revision	Sections	Date	Author	Description
1.00	All	4/18/96	JDB/RJS	Introduction of manual.
2.00	All	7/9/96	JDB	Revision made due to problems found in training and changes to the repair software.
3.00	All	5/28/97	JDB	Revisions made for support of Nellcor SpO_2 module.
4.00	All	10/1/98	JDB	Added schematics, board layouts and bill of materials, miscellaneous corrections.

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CAUTION: PRIOR TO DOING REPAIR WORK, USE GROUNDING MAT AND ANTI-STATIC WRIST STRAP TO MINIMIZE RISK OF DAMAGE TO SENSITIVE ELECTRONIC COMPONENTS.

1.1 To Service Personnel:

Read and understand the Welch Allyn Vital Signs Monitor Operator Manual and this Service Manual. The information contained in both of these publications is subject to change without notice and should not be construed as a commitment by Welch Allyn, Inc.

Welch Allyn assumes no responsibility for any errors that may appear in this manual. If the product and/or its operation varies significantly from any description herein, please contact the WELCH ALLYN TECHNICAL SERVICE DEPARTMENT:
1-800-450-9275
(828) 684-4895
Fax (828)687-9323

Welch Allyn, Inc.
95 Old Shoals Road
Arden, North Carolina 28704

This product has been designed to provide a high degree of safety and reliability. However, we can not guarantee against: deterioration of components due to aging, normal wear, tampering, and abuse.

All service and repairs must be performed by authorized Welch Allyn personnel or agents, using approved Welch Allyn replacement parts and approved process materials. Failure to so will invalidate the product warranty. Please refer to the product warranty for specific coverage.

Welch Allyn, Inc.
95 Old Shoals Road
Arden, North Carolina 28704
USA
1 800 450-9275

CAUTION WHEN USING ADHESIVES:

ALWAYS WEAR SAFETY GLASSES AND PROVIDE ADEQUATE VENTILATION WHEN USING ADHESIVES, THEIR ACCELERATORS AND RTV SEALANTS. READ, UNDERSTAND, AND COMPLY WITH SAFETY RECOMMENDATIONS IN THE MATERIAL SAFETY DATA SHEET MSDS) FOR THESE MATERIALS. SUPER-GLUES (CA ADHESIVES) CAN CAUSE CORNEAL DAMAGE IF ACCIDENTLY SQUIRTED IN THE EYES, AND CAN SPONTANEOUSLY COMBUST IF SPILLAGE IS WIPED UP WITH CLOTH OR PAPER TISSUES. READ THE WARNINGS AND CAUTIONS PRINTED ON THE BOTTLES OR TUBES OF THESE GLUES!

1.2 Limited Warranty

Welch Allyn warrants the Welch Allyn Vital Signs Monitor, when new, to be free of defects in material and workmanship and to perform in accordance with manufacturer's specifications for a period of two years from the date of purchase from Welch Allyn or its authorized distributors or agents. Welch Allyn will either repair or replace any components found to be defective or at variance from manufacturer's specifications within this time at no cost to the customer. It shall be the purchaser's responsibility to return the instrument to Welch Allyn or an authorized distributor, agent or service representative. This warranty does not include breakage or failure due to tampering, misuse, neglect, accidents, modification or shipping. This warranty is also void if the instrument is not used in accordance with manufacturer's recommendations or if repaired by other than Welch Allyn or an authorized agent. Purchase date determines warranty requirements. No other express warranty is given.

To receive service assistance or to ask questions regarding this warranty, please call or write:

Welch Allyn Technical Services Dept.
95 Old Shoals Road
Arden, North Carolina 28704 USA
1 (800) 450-9275 or (828) 684-4895
Fax: (828) 687-9323

Service Policy

All repairs on products under warranty must be performed or approved by a Welch Allyn Service Center. *Unauthorized repairs will void the warranty*. Products out of warranty should be repaired by qualified electronics personnel or a Welch Allyn Service Center.

Technical Assistance

If you have an equipment problem that you cannot resolve, call the Welch Allyn Service Center nearest you for assistance. Technical service support is available to you by telephone on normal business days, from 8:30AM until 4:30PM Eastern Standard Time at the phone numbers listed on the next page.

Before returning a product for repair you must obtain authorization from Welch Allyn. An RGA (Return Goods Authorization) number will be given to you by our service personnel. Be sure to note this number on the outside of your shipping box. Returns without an RGA number will not be accepted for delivery.

Welch Allyn Service Centers

For Service or Repair

USA Customers

Welch Allyn, Inc.
Technical Service Centers
95 Old Shoals Road
Arden, NC 28704-9739 USA
Phone: 828-684-4895
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Technical Service Centers
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1.3 Basic System Description

Introduction

The Welch Allyn Vital Signs Monitor is designed to non-invasively and automatically measure systolic and diastolic pressure, pulse rate, temperature and oxygen saturation (SpO_2) for adult and pediatric patients. All pressure, pulse, temperature and SpO_2 values are displayed on large, easy-to-read displays, and may be printed via an integrated thermal printer, as desired.

The rechargeable battery and wide variety of mounting accessories make the Clinical Monitor convenient for many locations. The operator may choose any combination of simultaneous measurement modalities. This flexibility, combined with features such as programmable alarms and automatic BP cycles, makes the Clinical Monitor ideal for a wide variety of patient monitoring needs.

Refer to the Operator Manual PART NUMBER 5200-85 (SPECIFY LANGUAGE) Section 1 for complete information on Indications For Use, Special Features, Supplies and Accessories

1.4 Basic System Operation

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1.5.1 Blood Pressure Operating Modes
- a. Max/Min Blood Pressure and Pulse Ranges
- b. Blood Pressure Manual Mode
- c. Blood Pressure Auto Mode

1.5.2 Temperature Operating Modes
- a. Max/Min Temperature Ranges
- b. Temperature Normal Mode
- c. Temperature Monitor Mode

1.5.3 SpO_2 Operating Mode
- a. Max/Min SpO_2 Ranges
- b. SpO_2 Monitor Mode

1.5.4 Pulse Rate Feature
- Max/Min Pulse Rate Ranges

1.4.1 Blood Pressure Operating Modes

When a blood pressure measurement cycle is initiated, the cuff will automatically be inflated to the operator selected pressure level.

The cuff will immediately begin to deflate in a stepped fashion and will determine systolic pressure and diastolic pressure from the pulses sensed by the cuff at various pressure levels. This is the oscillometric method of non-invasive blood pressure monitoring.

Blood pressure measurements may be initiated manually, or automatically at time intervals determined by the user.

At the completion of a measurement cycle the systolic and diastolic pressures are displayed. If the Monitor is in Automatic Mode, the measured values are kept on display until the next BP measurement is initiated. When not in Automatic Mode, the measured values are displayed for two minutes, after which time the display screen is blanked. The most recent BP measurement may be recalled by pressing the REVIEW button.

When in Automatic Mode, if the unit is unable to determine the systolic or diastolic value, the measurement will be automatically repeated once.

1.4.1.a. Max/Min Blood Pressure Ranges

The maximum and minimum ranges of blood pressure are detailed below:

Measurement	**Maximum**	**Minimum**
Systolic Pressure	250 mmHg	60 mmHg
Diastolic Pressure	160 mmHg	30 mmHg

1.4.1.b. Blood Pressure Manual Mode

In the Manual Mode, a single blood pressure determination is made only when the START button is pushed. The manual mode is the default mode of operation for blood pressure determinations.

A measurement cycle may be canceled at any time by pressing the CANCEL button. This action immediately initiates a rapid cuff deflation.

The blood pressure measurement data will appear on the display immediately following the measurement. The display will blank after two minutes. If the display is blanked, pressing the REVIEW button on the front panel will recall the measurement. Up to 99 prior measurements are available for review or printing.

In Blood Pressure Manual Mode, the following alarm limits may be activated; SYSTOLIC HIGH LIMIT, SYSTOLIC LOW LIMIT, DIASTOLIC HIGH LIMIT, DIASTOLIC LOW LIMIT, PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT. Blood pressure determinations which activate alarms are indicated by flashing displays and a repetitive audible tone. If an alarm limit is violated, subsequent blood pressure determinations may be made only after the alarm condition is reset by pressing any button on the Monitor's display.

1.4.1.c. Blood Pressure Automatic Mode

The Automatic Blood Pressure Mode is entered by pressing the AUTO button. Pressing the AUTO button displays a choice of 10 cycle interval times as follows: "st" (STAT mode) 3 min, 4 min, 5 min, 10 min, 15 min, 30 min, 45 min, 60 min and 90 min. These choices represent the time interval from the beginning of one cycle to the beginning of the next automatic cycle. STAT mode allows the monitor to take continuous blood pressure measurements for 15 minutes. In addition, the operator may choose to disable the Auto Mode by choosing "—" (two dashes).

A measurement cycle may be canceled at any time by pressing the CANCEL button. This action immediately initiates a rapid cuff deflation.

The blood pressure measurement data will appear on the display immediately following the measurement and will remain displayed until the next measurement cycle is initiated.

1.4.1.c. Blood Pressure Automatic Mode continued

In Blood Pressure Auto Mode, the following alarm limits may be activated; SYSTOLIC HIGH LIMIT, SYSTOLIC LOW LIMIT, DIASTOLIC HIGH LIMIT, DIASTOLIC LOW LIMIT, PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT. Blood pressure determinations which activate alarms are indicated by flashing displays and a repetitive audible tone. Any alarm limit violation must be reset to continue automatically timed blood pressure determinations. The alarm may be reset by pressing any button on the monitor's display.

1.4.2. Temperature Operating Modes

Thermistor Thermometry measurements are made with the DIATEK/Welch Allyn SureTemp4TM thermometer. Oral and rectal probes utilize single-use disposable probe covers which limit cross-contamination. Oral or rectal temperatures are taken using 'Normal' or 'Monitor' operating modes. Auxiliary temperatures may be taken using the oral probe in the monitor operating mode.

In the normal mode the thermometer's microprocessor "predicts" body temperature in about 4 seconds for oral temperatures and in about 15 seconds for rectal temperatures. The monitor mode displays the patient's actual temperature after 3 minutes and will continue to display an updated temperature as long as the probe remains in place.

Temperature readings may be displayed in Fahrenheit or Celsius scales.

1.4.2.a. Max/Min Temperature Ranges

Readings	Normal Mode	Monitor Mode
Temperature	Max 108.0F Max 42.2C	Max 108.0F Max 42.2C
	Min 84.0F Min 28.9C	Min 84.0F Min 28.9C

1.4.2.b. Temperature Normal Mode

In Normal Mode, the device will measure temperature at discrete intervals and then calculate the rate of change according to a known algorithm. This allows the thermometer to predict the end point that the thermistor would reach if it were left in the mouth until it reached mouth temperature. This predictive feature allows the thermometer to arrive at an accurate oral temperature reading in approximately 4 seconds.

Normal mode is the default operating mode for temperature determinations.

Operator selectable patient alarm limits are not available in Temperature Normal Mode. However, temperatures which are outside of the operating range of the device will be noted on the temperature display.

1.4.2.c. Temperature Monitor Mode

Continuous Monitor Mode operation is normally used for longer term monitoring and when difficult situations prevent accurate temperatures from being taken in the normal mode. The probe must be in contact with tissue for at least three (3) minutes for accurate temperature measurement. Monitor mode temperatures may not be identical to predicted 'Normal' temperatures because of ambient temperature influence and other factors. The trend in temperature is the important standard to be observed when in the 'Monitor' mode.

Operator selectable patient alarm limits are not available in Temperature Normal Mode. However, temperatures which are outside of the operating range of the device will be noted on the temperature display.

1.4.3 SpO_2 Operating Mode

The Welch Allyn Vital Signs Monitor incorporates either the Nonin® pulse oximetry system or the Nellcor® pulse oximetry system which determines arterial oxyhemoglobin saturation (% SpO_2) by measuring the absorption of red and infrared light passed through the tissues. Changes in absorption caused by pulsation of blood in the vascular bed are used to determine arterial saturation and pulse rate.

Oxygen saturation percent is calculated with each pulse detected, and thus the monitor display is continually updated. The pulse signal bar graph is an indicator of the strength and quality of the detected pulses.

When SpO_2 is measured, the patient's pulse rate is also measured and displayed. A pulse rate measurement from the SpO_2 determination overrides a pulse rate measurement derived from a blood pressure measurement.

In SpO_2 monitoring mode operator selectable alarm limits for low SpO_2 % may be activated. A condition which violates the SpO_2 low limit alarm is indicated by a flashing display and repetitive audible tone. Should a patient alarm condition for ≤ or pulse rate occur, the Monitor will indicate an alarm condition (flashing & beeping) while continuing to monitor and display the patient's current SpO_2%. The alarm will automatically reset when the patient's condition returns to within the preset alarm parameters.

Should a patient alarm condition for SpO_2 or pulse rate occur, the operator may invoke "Silence Mode" by pressing the SILENCE button. This will silence the audible tone (display will continue to flash), while the practitioner attends to the patient and the monitor. Silence mode resets automatically after 30 seconds, or when the patient's condition returns to within the preset alarm parameters.

Removal of the SpO_2 sensor from the patient will initiate an alarm. To reset the sensor alarm, press any button on the monitor's display.

SpO_2 is generally measured via pulses detected using a finger sensor. However, for certain situations SpO_2 may be measured at alternate sites including the earlobe, forehead and toes. Special sensors must be employed in these situations.

1.4.3.a. Max/Min SpO_2 Ranges

The SpO_2 sensor is designed to detect oxygen saturation as follows.

	Maximum	Minimum
SpO_2	99%	40%

1.4.3.b. SpO_2 Monitor Mode

The SpO_2 monitor performs most accurately with the finger clip sensor, which may be used on all fingers except the thumb. The finger clip sensor is recommended for spot checks or short term (<30 minutes) continuous monitoring.

The device determines arterial oxyhemoglobin saturation (SpO_2 %) by measuring the absorption of red and infrared light passed through the tissue. Oxygen saturation and pulse rate are displayed on the LED digital display. On each detected pulse, the pulse signal bar graph flashes. The intensity of this signal is a simple visual indicator of wave-form signal strength, and can identify situations where the pulsatile nature of the tissue may not be adequate for an accurate SpO_2 reading. The update interval of the bar graph should correspond to the patient's pulse rate. This is an indication of the quality of the SpO_2 signal.

1.4.4 Pulse Rate Feature

The Welch Allyn Vital Signs Monitor is capable of determining pulse rate as an adjunct to the blood pressure measurement and the SpO_2 measurement.

The pulse rate, in beats per minute, will be determined primarily from the SpO_2 measurement methodology. In the case where SpO_2 is not available, or is disabled, the pulse rate display will be driven from data collected as part of the blood pressure measurement method.

There are two operator selectable alarm limits for the pulse rate. They are PULSE RATE HIGH LIMIT and PULSE RATE LOW LIMIT. Pulse rates which activate alarm limits are indicated by a flashing display and a repetitive audible tone.

Should a pulse rate alarm occur when the pulse rate measurement is derived from the blood pressure measurement, no subsequent blood pressure or pulse rate measurements may be made until the alarm is reset. The alarm may be reset by pressing any button on the monitor's display.

Should a pulse rate alarm occur when the pulse rate measurement is derived from the SpO_2 measurement, the monitor will indicate an alarm condition (flashing & beeping) while continuing to monitor and display the patient's current SpO_2% and pulse rate. The alarm will automatically reset when the patient's condition returns to within the preset alarm parameters.

Should a patient alarm condition for pulse rate occur during SpO_2 monitoring, the operator may invoke "Silence Mode" by pressing the SILENCE button. This will silence the audible tone (display will continue to flash), while the practitioner attends to the patient and Monitor. Silence mode resets automatically after 30 seconds, or when the patient's condition returns to within the preset alarm parameters.

1.4.4.a. Max/Min Pulse Rate Ranges

The maximum and minimum pulse rate ranges are as follows:

	Maximum	**Minimum**
Pulse Rate	200 bpm	40 bpm

Figure 1.5 Block Diagram of Unit Operation

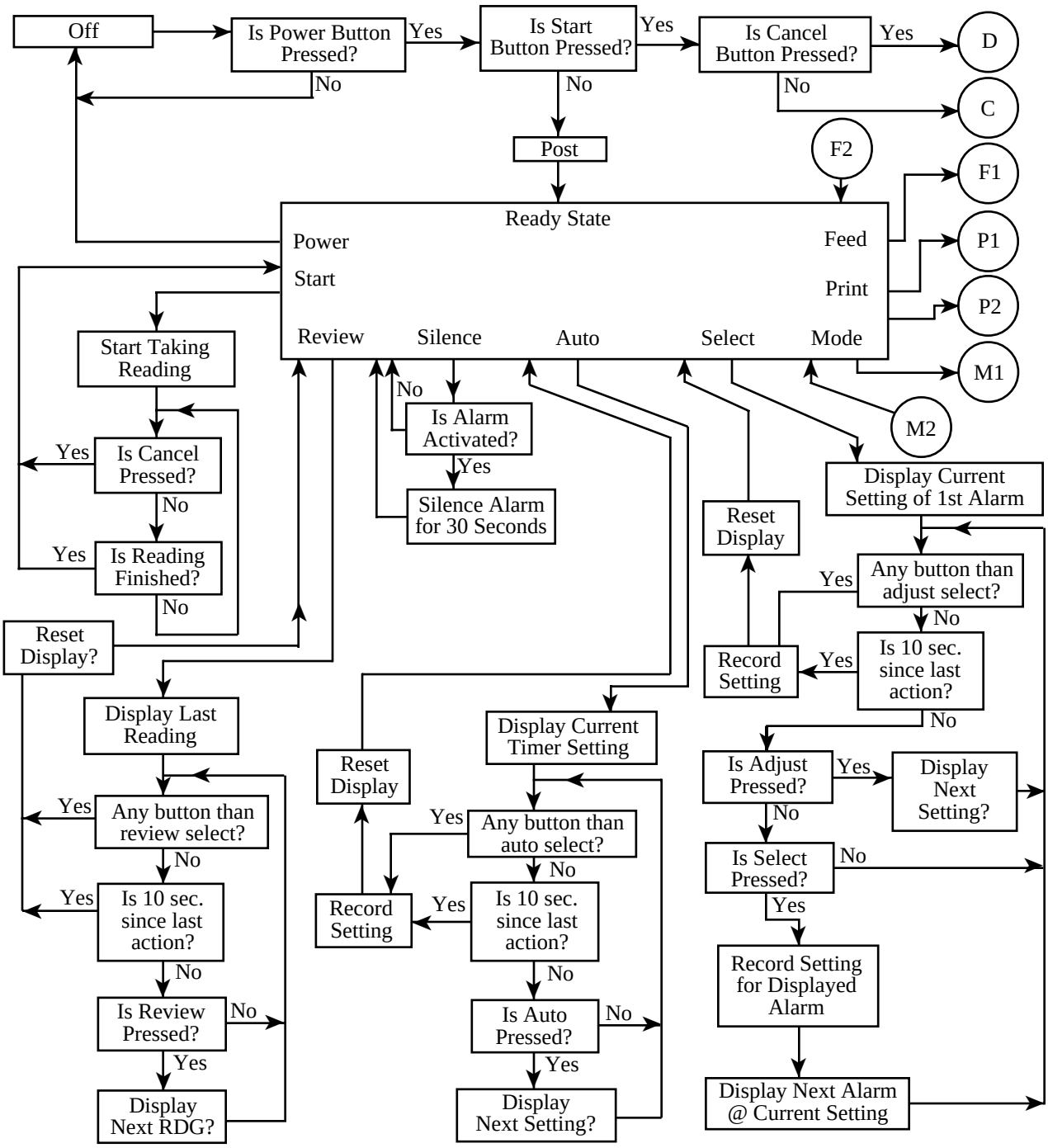
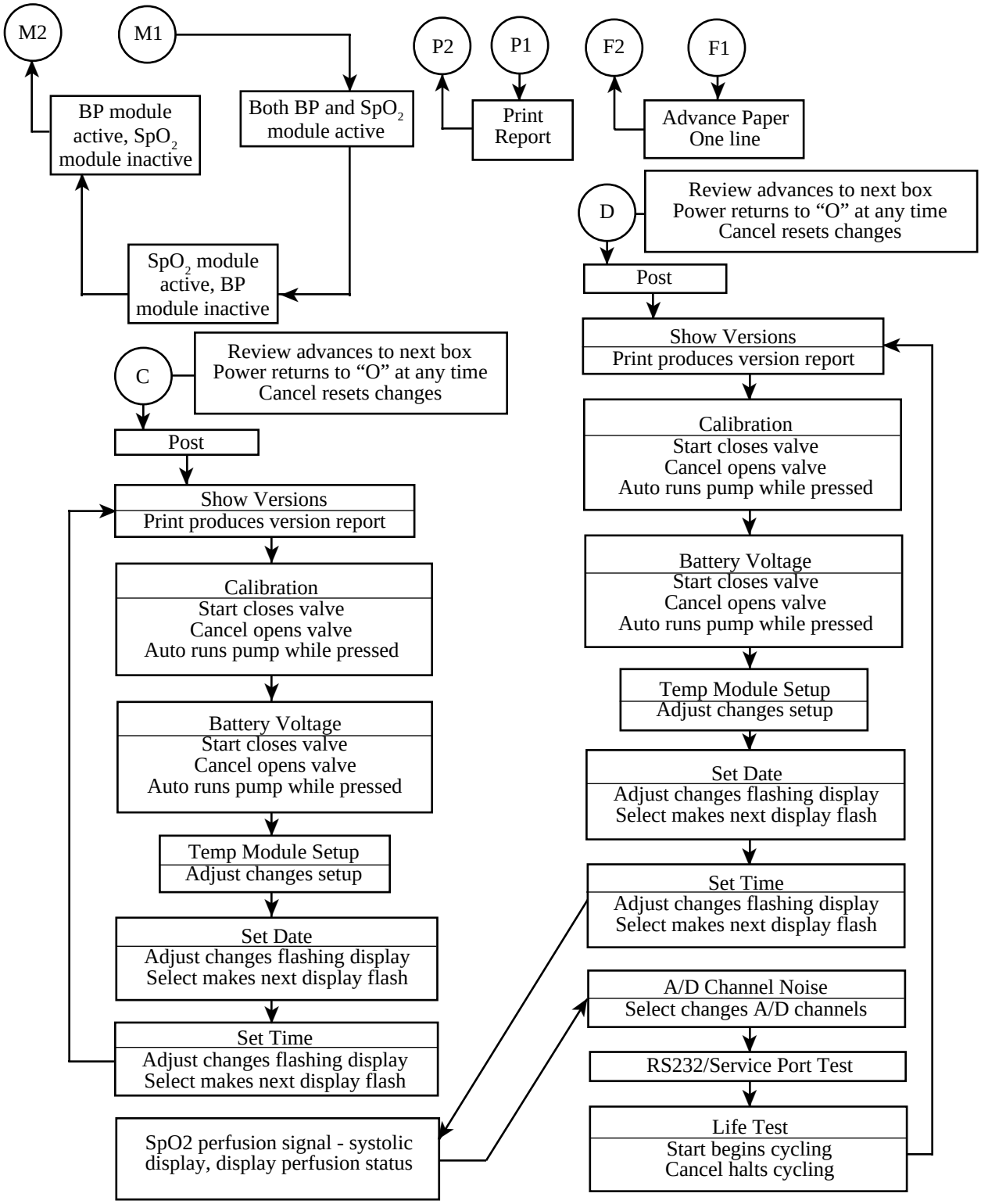


Figure 1.5 Block Diagram of Unit Operation



1.6 Specifications

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1.6.1 Performance Specifications

1.6.2 Technical Specifications
- a. Mechanical Specifications
- b. Electrical Specifications
- c. Environmental Specifications

1.6.3 Printer Specifications

1.6.1 Performance Specifications

The performance specifications of the Clinical Vital Signs Monitor are as follows:

CUFF PRESSURE RANGE
0 mmHg - 300 mmHg

INITIAL CUFF INFLATION
120 mmHg, 140 mmHg, 160 mmHg, 200 mmHg, 240 mmHg or 280 mmHg depending on pressure preset level.

SYSTOLIC DETERMINATION
Maximum: 250 mmHg
Minimum: 60 mmHg

DIASTOLIC DETERMINATION
Maximum: 160 mmHg
Minimum: 30 mmHg

BLOOD PRESSURE ACCURACY
Blood pressure accuracy meets or exceeds SP10-1992 AAMI standards for non-invasive blood pressure accuracy (AAMI standard: ± 5 mmHg mean error; 8 mmHg standard deviation). Blood pressure accuracy is validated for pressure measurement using the upper arm only.

BLOOD PRESSURE DETERMINATION TIME
20 seconds to 45 seconds typical, 140 seconds maximum.

PULSE RATE DETERMINATION
Maximum: 200 bpm
Minimum: 40 bpm

PULSE RATE ACCURACY

SpO_2 Module Heart Rate	±3.0%
Blood Pressure Algorithm Heart Rate	±5.0%

OVERPRESSURE CUTOFF
295 mmHg to 330 mmHg

TEMPERATURE DETERMINATION

Normal Mode	Maximum	108.0F (42.2C)
	Minimum	84.0F (28.9C)
Monitor Mode	Maximum	108.0F (42.2C)
	Minimum	84.0F (28.9C)

TEMPERATURE ACCURACY
Temperature accuracy meets ASTM E112-86: “Standard Specification for Electronic Thermometer for Intermittent Determination of Patient Temperature.”

TEMPERATURE DETERMINATION TIME
Normal Mode: ORAL: 4 seconds typical, 15 seconds maximum
Monitor Mode: ORAL: 3 minutes.

OXYGEN SATURATION RANGE (SpO_2%)
40-99% oxygen saturation

SpO_2 ACCURACY
±3% in the range of 70-99% oxygen saturation (1 Standard Deviation)

BATTERY CHARGING
To at least 90% capacity in 12 hours. Unit will operate and charge battery simultaneously when connected to power source.

1.6.2 Technical Specifications:

1.6.2.a Mechanical Specifications

Dimensions

Height	6.5 inches	(16.5cm)
Length	8.6 inches	(21.8cm)
Depth	5.0 inches	(12.7cm)

Weight

Approximately 6 pounds (2.8Kg)

Color

Oral Temperature Probe - Blue
Rectal Temperature Probe - Red

Mounting

Self-supporting on rubber feet
IV Pole Mountable
Custom Mobile Stand
Wall Mountable
Attaches to Bed Rail

Portability

-May be hand carried when held by the recessed handle.
-When attached to an IV pole, or mounted on its custom mobile stand, the monitor and accessories can be wheeled from patient to patient.
-When attached to the bed rail may be transported with the patient within the hospital environment.

Operator Instructions/Alarm Interpretation

Comprehensive Operator Manual available. Quick reference operator instructions and alarm interpretation are located on side panel labels.

1.6.2.b Electrical Specifications

Power Requirements
Patient-Rated isolation transformer is connected to AC mains:

North American Version 120VAC, 60 Hz.

International Versions: 220-240VAC, 50-60Hz.

Battery
6 v, 4 Ahr / 20 hr Sealed Rechargeable Lead Gel Cell

A fully charged battery will support 200 “typical” blood pressure determinations taken at 3 minute intervals (10 hours). Battery is 90-100% charged after 12 hours of charging. The battery automatically charges when the monitor is powered through the AC power transformer. The battery will charge faster when the instrument is not in operation.

1.6.2.c Environmental Specifications

Operating Temperature

+10C to +40C
+50F to +104F

Exception: Thermometry module will not operate below 60-F (16-C).

Storage Temperature

-20C to +50C
-4F to +122F

Relative Humidity

15 to 90% (non-condensing)

Operating Altitude

-170 m to + 4877 m
-557 ft. to +16,000 ft.

1.6.3 Printer Technical Specifications

Type
Thermal printer, dot matrix

Print speed
46 cps

Paper feed
friction type

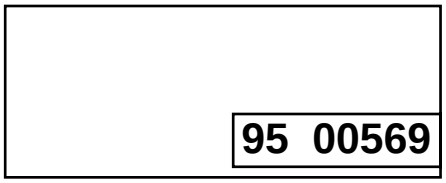
Voltage
5 v

Average power when printing
880 mA

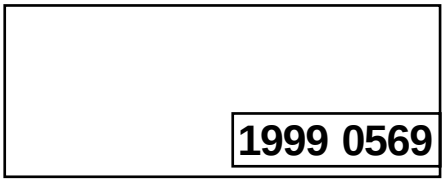
Paper width
57 - 58 mm

1.7 Serial Numbering System Defined

The serial plate for the 52000 Series (Welch Allyn Vital Signs Monitor) is located on the bottom of the unit. The serial number consists of seven digits.



or



The two or four digits on the left are the year of manufacture.

The four or five digits on the right are the sequence of build starting with 00001 annually.

(The example unit was the 569th unit built in 1995 or 1999).

1.8 Firmware Identification

To confirm these levels, place the unit into the “Configuration” mode. Hold down the ***Start*** button while the unit is being powered up.

Release the button when the main firmware version appears in the Systolic/Diastolic window. The SpO_2 option and Temperature option (if installed) will appear in the Temperature and SpO_2 displays.

Verify the firmware levels by reviewing the Repair Test Specifications document.

SECTION 2:

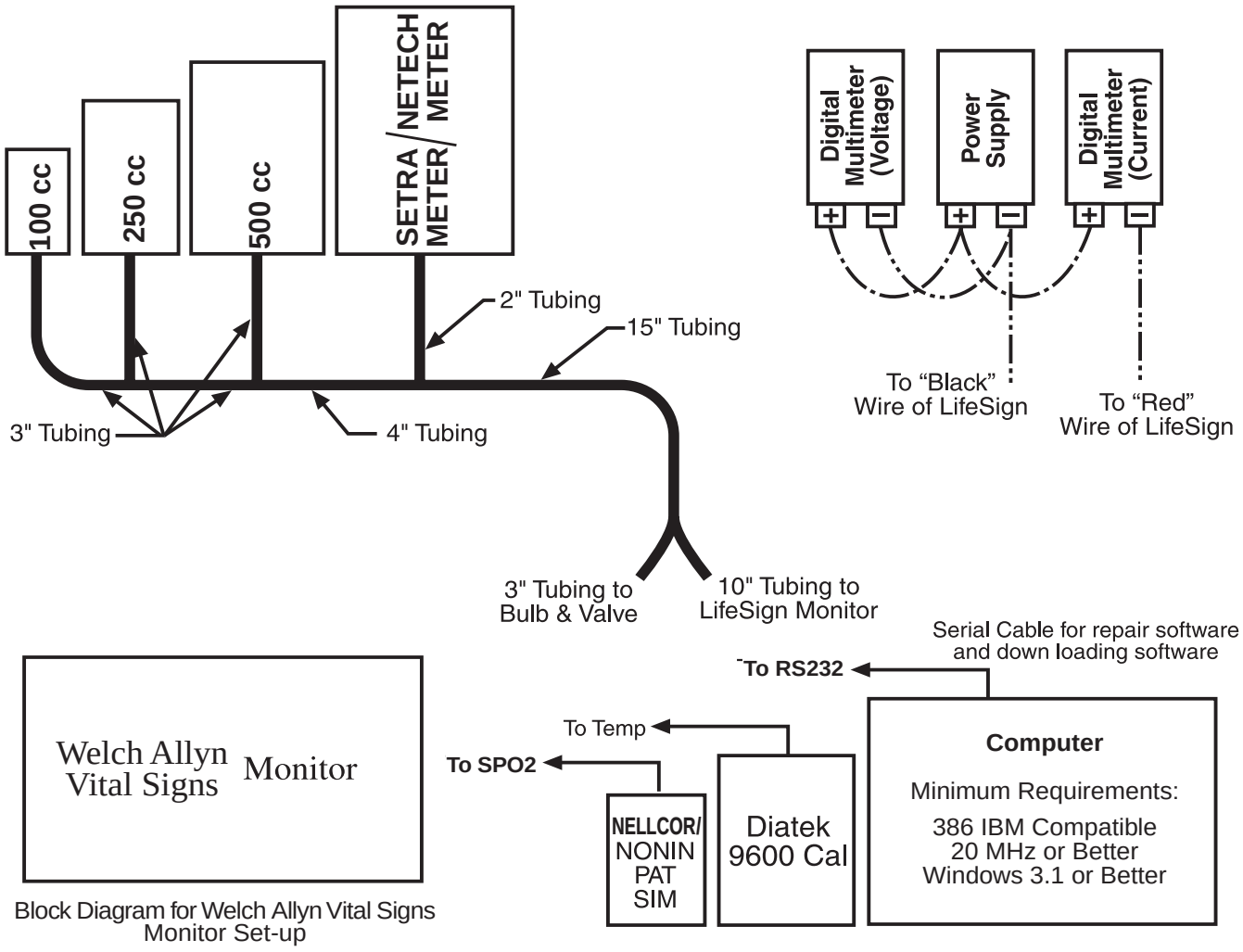
Service Set Up

2.1 Intent of Manual and Product Scope

This manual provides technical service and recalibration information to technicians authorized to repair and recalibrate Welch Allyn, Inc. products. When used in conjunction with the required test equipment and tools, technicians will be able to diagnose, repair, recalibrate, and test the Clinical Vital Signs Monitor. The manual includes: Calibration Software and Recalibration instructions, fault/cause analysis, step by step disassembly and reassembly procedures, repair, adjustment, and re-test procedures.

2.2.1 Test Equipment Bench Layout:

Figure 2.2.1 depicts recommended layout of test equipment and special tools for service and recalibration of the Welch Allyn Vital Signs Monitor.



Block Diagram for Welch Allyn Vital Signs Monitor Set-up

FIGURE 2.2.1

BENCH layout for recalibrating and testing Welch Allyn Vital Signs Monitor

Service Notes:

The following commercially available equipment is required for service and calibration of the Welch Allyn Vital Signs Monitor – not available from Welch Allyn.

– IBM compatible 386 20 MHz computer or better. The computer must have Windows 3.1 or higher, DOS 5.1 or higher, a serial port.

– 2 Digital Multi-Meters. These meters must have 4 1/2 digit displays for accuracy.

– Power Supply. 0-20 Vdc adjustable with 0-3A output.

– Oscilloscope. 60 MHz minimum.

2.2.2 Welch Allyn Vital Signs Service Tools

DESCRIPTION	TOOL #	LEAD TIME	COMPANY	OPTION I: Complete Service Set	OPTION II: Partial Service Set
100cc Test Volume	T112819	3 Weeks	Welch Allyn	●	●
250cc Test Volume	T112818	3 Weeks	Welch Allyn	●	●
500cc Test Volume	T112854	3 Weeks	Welch Allyn	●	●
Digital Timer	8456T12	3 Days	McMaster-Carr	●	●
NeTech Meter*	200-2000IN	3 Days	NeTech	▲	▲
– OR –					
Setra Meter* (0-10 PSIG)	2270-01	6-8 Weeks	Setra Systems		
Pliers	T112458	3 Weeks	Biltmore Tool	●	
Bulb And Valve	5088-01	3 Weeks	Welch Allyn	●	●
Keypad Engaging Tool	T112067	3 Weeks	Welch Allyn	●	
ESD Kit	T112469	Stock	Cameron & Barkley	●	
WIRE Cutters	T112486	Stock	Welch Allyn	●	
Tweezers	T112511	Stock	Welch Allyn	●	
Electronic Swabs	318M2	Stock	Welch Allyn	●	
Pneumatic Tubing (Cut)	97P24	Stock	Welch Allyn	●	●
“Y” Fitting	9586TPK4	2 Weeks	Festo	●	●
“T” Fitting (3)	9585TPK4	2 Weeks	Festo	●	●
Test Cable	130S28	3 Weeks	Welch Allyn	●	●
Pneumatic Clamps (3)	21730-001	Stock	VWR Scientific	●	●
Torque Screwdriver	T112917	Stock	Tool And Gauge	●	
Torque Screwdriver	T112918	Stock	Tool And Gauge	●	
Custom Repair Software	130S29E	Stock	Welch Allyn	●	●
#4 Phillips Bit	T112919	Stock	Biltmore Tool	●	
#6 Phillips Bit	T112933	Stock	Biltmore Tool	●	
T8 Torx Bit	T112464A	3 Weeks	Welch Allyn	●	
7/16" Wrench	T112990	Stock	McMaster Carr	●	
Cable Tie Tool	T112845	Stock	Newerk	●	
Nonin Patient Simulator	8000S	Stock	Nonin	●	●
Nonin Phantom Fingers	9440	Stock	Nonin	●	
Nonin Cable	8500-I	Stock	Nonin	●	●
Diatek 9600 Calibrator	01800-110	Stock	Diatek	●	
Diatek Cal. Key	06137-000	3 Weeks	Diatek	●	●
LG. Adult Cuff/Bag	5200-02	Stock	Welch Allyn	●	●
Pneumatic Tubing (Coiled)	5200-07	Stock	Welch Allyn	●	●
Service Manual	5200-86E	Stock	Welch Allyn	●	●
Nellcor Patient Simulator	SRC2	Stock	Nellcor	●	●
Nellcor Test Cable	EC-8	Stock	Nellcor	●	●

* Choose one of these meters for calibration. **DO NOT ORDER BOTH METERS.**

Allowing the bio-medical department to use a water bath to check temperature (measuring against a temperature standard) That standard must be accurate to with +/- 1F.

See Section 1.1 for ordering tools.

2.3 Replacement Parts – Welch Allyn

In addition to individual parts listed below, SPARE PARTS KITS have been made up for your convenience. This assures that you will have all the mounting materials and other small items needed for a repair. The foam pads mounted on the battery are one such example. Kits will not be broken down. FOR AUTHORIZED REPAIR SITES ONLY.

Welch Allyn Replacement Parts:

PART#:	DESCRIPTION:
130S1-E	English Front Housing Kit
130S1-S	Spanish Front Housing Kit
130S1-F	French Front Housing Kit
130S1-G	German Front Housing Kit
130S1-I	Italian Front Housing Kit

Includes: front housing with loose labels. Four different types of labels for the four different configurations i.e.:
BP w/Printer Only, BP w/Printer + SpO_2,
BP w/Printer + Temp, BP w/Printer + Temp + SpO_2

130S2	Front Housing Switch Array
130S3*	Main PCB Assembly Includes: hardware
130S4*	Display PCB Assembly Includes: hardware
130S5*	Valve
130S6	Pneumatic Connector Includes: connector, washer, nut, and grommet
130S7*	Pump Assembly Includes: pump, cable tie mount, 2 cable ties, foam pads, instructions, specifications
130S8E	English Rear Housing Kit
130S8F	French Rear Housing Kit
130S8G	German Rear Housing Kit
130S8I	Italian Rear Housing Kit
130S8S	Spanish Rear Housing Kit
130S9	Power Jack
130S10	Back Panel Includes: panel and hardware
130S11	Tubing Assembly Includes: all tubing, “T” fitting, instructions
130S12	Pressure Switch Includes: switch and hardware
130S13	Bumpers (2 ea.)
130S14	Battery Access Plate Includes: plate and hardware
130S15	Wire Harness Includes: 14 pin MTA connector, 3 pin MTA connector, faston receptacles for the power supply, power jack, battery, and valve lead wires all assembled
130S16	Temperature Plug
130S17	Printer Assembly Includes: thermal printer, double faced adhesive foam all assembled
130S18*	Printer Housing Includes: housing, switch array, PCB, hardware, flex strip
130S19	RS232 Cable Includes: DB9 connector, hardware, 4 pin MTA, lead wires all assembled

PART#:	DESCRIPTION:
130S20*	SpO_2 PCB (Nonin) Includes: PCB with cable attached, DB9 connector and cable (not attached), and hardware with instructions
130S21	SpO_2 Sensor Interconnect (Nonin) Includes: lead wires and 4 pin MTA connector
130S22*	Temperature PCB Assembly Includes: PCB, hardware, lead wire and connectors
130S23	Temperature Connector Includes: connector, lead wires and hardware
130S24	Temperature Probe Housing Includes: housing and hardware
130S26	Main PCB Fuse
130S27	Printer Paper Cover
130S28	Cable, DB9 Female to DB9 Female 42" long
130S29	Software, Repair
130S34	Kit, Repair, Nellcor SpO_2 PCB with connector
130S35	Kit, Repair, SpO_2 Cable (Nellcor)
130S36	Kit, Repair, SpO_2 Cable to Main (Nellcor)
130S37	Upgrade, Software, Version 3.11
41P100**	Check Valve
117S144**	DC to DC Converter
114S588**	Pressure Sensor
66S530**	“Printer, Flat Cable”
5200-01	Cuff Assy, Adult with 1 tube bag
5200-02	Cuff Assy, Lg Adult with 1 tube bag
5200-03	Cuff Assy, Child Print with 1 tube bag
5200-04	Bag, Adult with cut tube
5200-05	Bag, Lg Adult with cut tube
5200-06	Bag, Child with cut tube
5082-59	Cuff, Adult Black
5082-61	Cuff, Lg Adult Black
5082-63	Cuff, Child Print
5200-07	Pressure Hose with new Luer fitting
5200-08	Calibration T connector
5200-20	Probe, Oral 9 Ft, Diatek
5200-22	Probe, Rectal 9 Ft, Diatek
5200-40	Sensor, SSpO_2 Finger Clip (3 meter cord) (Nonin)
5200-41	Sensor, SpO_2 Ear Clip (Nonin)
5200-42	Sensor, SpO_2 Flex (Nonin)
5200-44	Sensor, SSpO_2 Reflectance (Nonin)
5200-45	Holder, SpO_2 Reflectance Sensor (Nonin)
5200-46	Sensor, SpO_2 Adult Finger Flexi-form (Nonin)
5200-47	Sensor, SpO_2 Ped Finger Flexi-form (Nonin)
5200-50	Tape, SpO_2 Sensor Attachment (Nonin)
5200-51	Tape Strips, Hydrogel for SpO_2 (Nonin)
5200-52	Cable, SpO_2 Extension 3 Ft (Nonin)
5200-53	Kit, SpO_2 Finger Phantom Calibration (Nonin)
5200-54	Sensor, SpO_2 Finger Clip (1 meter cord) (Nonin)
5200-12	Tubing, straight 8 ft. with fitting
5200-56	Pediatric Finger Clip Sensor (Nonin) 9 ft. cable
5200-55	Extension Cord 10 ft. for SpO_2 sensor (Nonin)

PART#:	DESCRIPTION:
5200-60	Mobile Stand Kit
5200-61	Mobile Stand Kit, Modified
5200-62	Wall Mount Kit
5200-63	Wall Mount Kit, Modified
5200-64	IV Pole Kit
5200-65	IV Pole Kit, Modified
5200-66	Bed Rail Kit
5200-67	Bed Rail Kit, Modified
5200-68	Cuff Clip
5200-69	Accessory Pack
7052-25	Printer Paper (5 rolls)
5200-101	Transformer, USA 120V, 60 Hz
5200-102	Transformer, Europe 220V, 50 Hz
5200-103	Transformer, UK 230V, 50 Hz
5200-103	Transformer, Australia 230V, 50 Hz
5200-110	Power Cord, USA/Japan
5200-111	Power Cord, Europe
5200-112	Power Cord, UK
5200-113	Power Cord, Australia
5200-114	Power Cord, Switzerland
5200-115	Power Cord, South America
5200-84	Battery, 6 Volt Lead Acid
D-25	OXISENSOR II adult digit oxygen transducer (Nellcor)
D-25L	OXISENSOR II adult digit oxygen transducer with long cable (Nellcor)
D-20	OXISENSOR II pediatric oxygen transducer (Nellcor)
R-15	OXISENSOR adult nasal oxygen transducer (Nellcor)
I-20	OXISENSOR II infant digit oxygen transducer (Nellcor)
EC-8	Extension Cable – 8 foot (Nellcor)
OXICLIQ-A	Adult oxygen transducer for use only with OXICLIQ sensor cable OC-3 (Nellcor)
OXICLIQ-P	Pediatric oxygen transducer for use only with OXICLIQ SENSOR CABLE MODEL OC-3 (Nellcor)
OXI-A/N	OXIBAND adult/neonatal oxygen transducer (Nellcor)
OXI-P/I	OXIBAND pediatric/infant oxygen transducer (Nellcor)
RS-10	Reflectance oxygen transducer (Nellcor)
D-YS	DURA-Y oxygen transducer (Nellcor)
SRC-2	Portable oximetry tester (Nellcor)
DS100A	DURASENSOR adult oxygen transducer (Nellcor)
OC-3	Cable, OXICLIQ Sensors (Nellcor)
D-YSE	Ear Clip (use with DURA-Y sensor) (Nellcor)
D-YSPD	Pedicheck Pediatric Spot-Check (use with DURA-Y Sensor) (Nellcor)
ASP-3	Sensor Assortment Pack (Nellcor)
05031-101	Diatek Probe Covers
5200-25	Temperature Cal. Key
01800-210	Model 9600 Temperature Cal. Kit 110V.
5200-85E	Operations Manual
5200-86E	Service Manual

* - Indicates that these parts can be traded in. If the part is under warranty, with a trade in you get full credit. If the parts is out of warranty, you will get a 40% discount from the price."

** - Only regional service centers may purchase these parts.

See section 1.1 for ordering parts.

2.4 Welch Allyn Vital Signs Monitor Maintenance and Service Support

Owner Maintenance: Non-Technical customers can perform normal maintenance per the instructions provided in the Operator Manual, Section **V**. End users will be able to perform basic operations such as replacement of: hoses, cuffs, probes, printer paper and batteries. On this level the unit will not be opened. However, opening of the WELCH ALLYN VITAL SIGNS MONITOR by untrained individuals may damage the unit and void the warranty.

Technical Service/Repair/Re-calibration: Properly trained and equipped bio-medical departments and service centers will be able to utilize the content of this Service Manual. Technical skills in electronics and PC skills are required. These departments and centers must have service manual and re-calibration software, repair tools and test equipment as listed in this manual. They must also have minimum recommended quantities of repair parts and sub-assemblies. See the listings of repair parts and kits in this manual.

SECTION 3:

Problem Diagnosis

3.1 Overview

The Welch Allyn Vital Signs Monitor can be diagnosed and repaired to board level without the necessity of electrical schematics.

Repair/Replace decisions will be made on the basis of information obtained from Calibration Software, Test Software, Printed Troubleshooting tables as seen in this section and in the Error Code Chart.

With a few exceptions, individual circuit board components will not be on the repair bill of materials, and therefore can not be ordered.

3.2 Diagnostic Procedure for Returned Units

NOTES:
A. The word “unit” in this text refers to the WELCH ALLYN VITAL SIGNS MONITOR.
B. Menu|Choice represents menu commands. Rather than use the phrase “choose the exit command from the File menu.”

1. Remove the battery from the unit. Connect the unit to the power supply. Set the power supply to 6.5 Vdc +/- 0.5 Vdc.

2. With a digital multi-meter, check the voltage of the battery. If the voltage of the battery is less than 6.0 Vdc, the battery needs to be charged. Up on completion of this procedure, place the battery back into the unit and plug in the charger. Let the battery charge for 8 hours. Next allow the unit to sit for 1 day and recheck the battery voltage. If the voltage is below 6.0 Vdc, change the battery. **(Reference section 4.15)**

3. Power up the unit. If the unit does not power up:
    A. Insure the power supply is on and has the correct requirements as called out in 1. (see above).
    B. The power supply is connected to the unit.
    C. Check that the fuse is not blown. **(Reference section 4.2)**
    D. Change the main PCB. **(Reference section 4.3)**
    E. Change the display PCB. **(Reference section 4.6)**

If the unit does power up:

4. To check the display PCB, observe the unit during power up. All of the LEDs should be lit for 1-2 seconds before the unit gets to its normal mode. If the unit has any LEDs out change the display PCB. **(Reference section 4.6)**

5 Run a couple of blood pressure cycles to ensure proper inflation/deflation and readings.

6. If the unit is not inflating/deflating properly:
    A. Open up the unit by removing the 6 housing screws.
    B. Check the unit for pinched tubing if the unit is deflating too slowly. With the housing opened, re-run the blood pressure cycle to see if the deflating problem has been fixed. Re-route tubing.
    C. If there are no pinched tubes, change the valve. **(Reference section 4.13)**

D. If this still does not clear up the problem of deflation too slow, change the pressure switch. **(Reference section 4.12)**
E. Power down the unit. Place unit into detailed test mode by holding down the "start" and "cancel" buttons as power is re-applied. Press the review button until "cal" appears in the systolic window. Press the "start" button to close the valve. Pump up the unit using the bulb and valve inflate the unit to 250 mmHg. Confirm the unit meets the specification for leak called out in the Repair Test Specification document. If the unit is leaking:
F. Pinch off the tubing leading to the pump. If this stops the leak, change the pump. **(Reference section 4.11)**
G. Pinch off the tubing leading to the valve. If this stops the leak, change the valve. **(Reference section 4.13)**
H. Pinch off the tubing leading to the transducer. If this stops the leak, change the transducer. **(Reference section 4.5)**
I. Pinch off the tubing leading to the pressure switch. If this stops the leak, change the pressure switch. **(Reference section 4.12)**

7. If the unit is inflating/deflating properly however there is no reading given, change out the main PCB. **(Reference section 4.3)**

8. **FOR THE PRINTER OPTION**: Load the printer with paper if there is no paper. Press the form feed button to see if that will advance the paper. Next, press the print button to see if the unit will print. If these functions do not work, first change the printer PCB and re-test. If the problem is still evident, change out the printer itself. **(Reference section 4.13)**

9. **FOR THE SpO_2 OPTION**: Connect the patient simulator to the unit SpO_2 connection by the Nonin or Nellcor cable (depending upon which is installed). Confirm readings equal to the specifications called out in Section 7. If there is no reading, change out the SpO_2 connector and PCB. **(Reference section 4.9 or 4.10 depending on which SpO_2 Module is installed)**

10. **FOR THE TEMPERATURE OPTION**: Plug in the Diatek 9600 calibrator and set it for 96.4 F/ 35.8 C or use a water bath between 84 F (28.8 C) and 106 F (41.1 C). Remove the temperature probe and view the temperature window on the display. Make sure the temperature is in the "monitor mode." This will be displayed at the bottom of the window. If the unit is not in monitor mode, wait approximately 40-60 seconds and the unit will automatically transfer into the monitor mode. Place the probe into the small hoe on top of the 9600 calibrator or into bath. If there is no reading place the probe back into its housing, remove and retry. If there is still no reading, change the probe and retry the test. If there is still no reading place the probe back into the housing, unplug the probe and plug in the cal-key, remove the probe and Confirm reading meets specifications called out in Section 7. If there is no reading at this point, change the temperature connector and PCB. **(Reference section 4.8)**

11. **FOR THE RS232 OPTION**: Connect the RS232 cable from the PC to the unit. Select ***Unit|Information*** in the repair software. If a communication error appears on the PC screen, check the connection to the unit and the PC. Select ***Tools|Options*** to insure that the communication port that the cable is connected to is selected. Re-try the test. If the error is still present change out the main PCB.

3.3 Calibration Procedure

3.3.1 VOLTAGE CALIBRATION

1. Connect the unit to the test station by hooking up the pneumatic tubing, cable from the PC, and removing the battery and connecting the power supply.

2. Place the unit into the “detailed test mode” by holding down the start and cancel buttons while powering up the unit. Allow the software versions to be displayed then press the review button until the unit displays “BAT” in the systolic window.

3. Go to the repair software and choose ***Calibrate|Voltage***. Adjust the power supply to between 5.6 Vdc and 5.9 Vdc.

4. View the digital multi-meter (DMM) that is connected to the power supply reading the voltage. Move the cursor to the “Calibrated Voltage” box and type in the voltage that you observe on the DMM. In the software, click on “Update.”

5. The software will then prompt you to enter in a “Calibration Signature.” Move the cursor to the box and enter the three initials of your name. Then click “OK.”

6. At this point you should see the voltage on the display of the WELCH ALLYN VITAL SIGNS MONITOR change to match that of the DMM.

7. Adjust the power supply to 6.5 Vdc ± .05 Vdc.

3.3.2 PRESSURE CALIBRATION

1. Connect the unit to the test station by hooking up the pneumatic tubing, cable from the PC, and removing the battery and connecting the power supply.

2. Place the unit into the “detailed test mode” by holding down the start and cancel buttons while powering up the unit. Allow the software versions to be displayed then press the review button until the unit displays “CAL” in the systolic window. Make sure that clamps are on the 100cc and 250cc volumes.

3. Go to the repair software and choose ***Calibrate|Manometer***.

4. Press the “Calibrate” button to begin the calibration procedure.

5. The software will first check to make sure that the units internal temperature is below 32°C. If it is not the user will be warned that they can not perform a calibration at this time.

6. If the temperature is within the 32°C limit the software will tell the unit to perform an auto-zero. If this is unsuccessful the user will be prompted to perform a zero potentiometer calibration. This is an automatic calibration. The user just needs to answer **YES** or **NO**. A **no** will cancel the calibration procedure.

7. Once a successful autozero has been completed the “Gain Calibration at 200 mmHg” box will be activated. This box consists of a slider control and a pressure display. To perform the span calibration pump the unit up to 200 mmHg +/- 5 mmHg using the bulb. Wait 15 seconds to allow the pressure to stabilize. Adjust the slide control until the reading on the PC matches as close as possible to the reading on the pressure standard. Once the difference has been minimized, Press “record” and proceed.

8. Once the gain calibration is complete the pressure calibration points can be calibrated. There are three points that require calibration, 95, 195 and 285 mmHg. First set the pressure to the desired value within +/- 5 mmHg of that value. Wait 15 seconds to allow the pressure to stabilize. Adjust the slide control until the reading on the PC matches as close as possible to the reading on the pressure standard. Press “record” after each setting. YOU MUST DO THIS FOR ALL THREE VALUES. Once this is completed press the “update” button.

9. The software will then prompt you to enter in a “Calibration Signature.” Move the cursor to the box and type the three initials of your name. Then click “OK.”

10. Press **Close** to exit the calibration dialog box.

3.4 Loading Unit Software

***WARNING: DO NOT REMOVE POWER OR TURN OFF UNIT DURING THE SOFTWARE LOADING OPERATION. The unit will be in an unrecoverable state if this happens.**

1. Plug the wall transformer into the Welch Allyn Vital Signs Monitor.

2. Connect the unit to the RS232 cable of the test station.

3. Start the Repair Software by clicking on its icon. Go into Unit/Update Software.

4. Press the “Select File” button in the software.

5. Choose the correct unit software (cbpXXX.mot) file per instructions from the manufacturer. (Where “XXX” is the number of the software version to be loaded)

6. Once the software file is selected, press the “OK” button. This will return you to the Repair Software. The Repair Software will then ensure that the cbpXXX.mot file you are about to load into the unit is “Valid.” If so, press the “Load” button in the software. The unit will take about 10 minutes to load the software. (If the software file you have chosen is “Not Valid,” repeat steps 4 and 5, choose the correct version and then proceed. If problems persist, please contact your nearest Regional Service Center.)

   NOTE: If the computer or the software malfunctions during the software loading operation, re-boot the computer, re-start windows and start the Repair Software. The Repair Software will start in the “Recovery Mode.” The software will prompt you to continue/ resume the software loading process.

3.5 Welch Allyn Vital Signs Monitor Self Diagnostic Fault Codes

The following is a list of all possible error codes and their meanings.

MAIN BOARD ERROR CODES

ERROR CODE	DESCRIPTION
CO1	User abort
CO2	Auto-zero failure
CO3	Inflation too fast
CO4	Inflation too long
CO5	Excessive noise
CO6	Outside measuring range
“ “	BP not available
E10	Over pressure
E11	Fail-safe violation
E12	Ambient temp. limit
E13	Battery failure
E20	A/D failure
E30	ROM failure
E31	RAM failure
E32	Factory EPROM checksum fail
E33	User EPROM checksum failure
E34	A/D converter failure
E35	SpO_2 PCB failure
E36	Temperature PCB failure
E37	Printer failure
E38	Real time clock failure

SpO_2 BOARD ERROR CODES (Both Nonin and Nellcor)

ERROR CODE	DESCRIPTION
“—“	Sensor error
E7	SpO_2 PCB bad
“ “	SpO_2 off

TEMPERATURE BOARD ERROR CODES

ERROR CODE	DESCRIPTION
E0.0	Stack RAM error
E0.1	Internal RAM test failure
E0.2	Internal ROM checksum failure
E0.3	Instrument error
E0.4	EEPROM checksum error
E0.5	RAM checksum error
E0.6	EEPROM busy too long
E0.7	EEPROM address write error
E1.0	External interrupt 0
E1.2	Transmitter interrupt
E1.3	Timer Y interrupt
E1.4	Timer 2 interrupt
E1.5	External counter interrupt
E1.6	Timer 1 interrupt
E1.7	Serial I/O
E1.8	Software break
E2.0	Low cal. resistor pulse width error
E2.1	High Cal. resistor pulse width error
E2.2	PTB resistor pulse width error
E2.3	Probe pulse width error
E2.4	Could not determine cause
E3.0	Low battery error
E3.1	PTB test error
E3.2	Outside operating temp. range
E4.0	Floating point overflow
E4.1	Log of zero undefined
E5.0	Q warmer transistor error
E5.1	C warmer transistor error
E5.2	Warmer protection circuit failure
E5.3	Probe warmer not warming
E5.4	Probe missing, thermistor failure
E5.5	Warmer circuit failure
E5.6	Warmer overheated
E5.7	Warmer watch-dog time out
E6.1	Serial overrun error
E6.2	Serial framing error

TEMPERATURE BOARD ERROR CODES (CONT'D)

ERROR CODE	DESCRIPTION
E6.3	No data time out error
E6.4	Transmit buffer overflow
E9.1	Undefined software state
C20	Probe missing or broken
C21	Probe Characterization aborted
P	Probe position
PC	Probe characterization
" "	Temperature off

3.6 Complaint/ Cause/ Corrective Action

COMPLAINT	CAUSE	CORRECTIVE ACTION
Does Not Power Up	Battery Voltage LOW	Check Voltage Level
	Battery Voltage Less Than 5.4 Volts	Charge Battery
	Fuse F1 Blown	Replace Fuse After Cause Of Short Identified
	Battery Connector	Verify Connection And Replace Required
	Charge Light not on when Charger Plugged in	Change Main PCB.U28 is blown.
Constant Alarm	Overpressure	Check For Pinched/Blocked Hose
	Hardware Fails	Verify Performance Of The Following Parts: A) Pressure Switch B) Transducer C) Valve D) Main PCB
Air Leak	Pneumatic Connector	Check Seals
	Pump	Verify Proper Operation
	Valve	Verify Proper Operation Check Valve Drivers
	Unit Tubing	Verify Connectors And Integrity Of Hoses
	Cuff	Verify Air Seal Of Coiled Hose And Cuff Connectors Verify Air Seal From Pneumatic Connector Of Welch Allyn Vital Signs Monitor To Coiled Hose.
	Overpressure Switch	Verify Connections And Integrity Of Hose. Verify Switch Operation.
SpO_2 Failure	SPO2 Board And Harness..	Replace Probe And Retest. Verify All Connections To The SpO_2 Board Replace SpO_2 Board.

COMPLAINT	CAUSE	CORRECTIVE ACTION
Temp Failure	Probe	Replace Probe And Retest
	Diatek Board & Harness	Verify All Connections To The Temperature Board.
	Opto-Reflector.....	Verify Probe Is Seen Only When Removed From Holster.
	Connector PCB	Verify That The Temp Probe Connector Is Properly Seated In The Connector On The Unit. Verify That The Connector From Diatek Board Is Connected To The Connector On The PCB.
	Temp. Error Code	See Page 19
Printer Failure	Flex Cable (Main PCB To Printer PCB).....	Verify That The Flex Cable From The Main PCB Is Fully Seated In The Board Cable Connectors.
	Flex Cable (Printer To Printer PCB).....	Verify That The Flex Cable From The Printer To The Printer PCB Is Fully Seated In The Board Cable Connector.
	Paper Jam.....	Check Condition Of Paper Roll In The Printer Housing.
	Printer Home Position	Verify That The Printer Head Fully Actuates The Printer Home Switch.
BP Readings High		See pages 17 & 18 for ways to check to ensure the monitor is accurate.

CHECKLIST FOR COMPARING AUTOMATED BP MONITORING TO MANUAL METHODS

- Blood pressure can vary between the left and right arm by as much as 20 mmHg on some patients. When comparing the Welch Allyn measurement to a manual reading on an opposite arm it is important to repeat the comparison after switching arms and then compare the average of both readings. This will help to eliminate the difference between the two arms.

- A person's blood pressure is continuously changing in reaction to their environment and physical state. Posture changes, conversation and other influences can easily cause a person's blood pressure to change dramatically. When comparing the Welch Allyn measurement to a subsequent manual reading on the same arm it is important to enure that the person's blood pressure has stabilized. To determine this, it is best to take a manual reading before and after the Welch Allyn reading. A stable subject should not have a change in systolic or diastolic of more than 5 mmHg.

- It is very important that both of the subject's arm remain in the same relative location throughout the test. One inch of elevation change will result in 1.8 mmHg change in the systolic and diastolic pressures.

- When taking the manual auscultatory reading it is very important to maintain a 3 mmHg/sec deflation rate. This deflation has been prescribed by the American Heart Association. Deflating the cuff too rapidly will result in an inaccurate blood pressure reading.

- Hearing acuity vary from individual to individual an can cause different blood pressure measurements on the same subject. This effect is compounded when a subject has very weak Korotkoff sounds. When taking auscultatory readings for comparison to the Welch Allyn, it is best to use a teaching stethoscope with two sets of binaurals and two persons trained in taking blood pressures. The two observers should write down their readings and not reveal the readings to each other, which may introduce bias. The two observers should agree within 5 mmHg for both systolic and diastolic, and the average of their readings used for the comparison. Inability of the two observers to agree within 5 mmHg denotes a subject which cannot be repeatedly measured by auscultation and should not be used for comparison.

- Proper cuff sizing is important. Using a cuff that is too small or too large will result in inaccurate blood pressure readings.

- Some situations can introduce a psychological bias in the auscultatory readings. For instance, a drug testing clinic wishing for subjects with systolic pressure below an acceptance threshold may result in biased low systolic readings, in some instances.

CHECKLIST FOR COMPARING BP MEASUREMENTS MADE WITH THE WELCH ALLYN TO OTHER AUTOMATED MONITORS

- The Welch Allyn monitor has been validated according to the AAMI protocol using auscultatory readings. Many other manufacturer's monitors have been validated to the AAMI protocol *intra-arterial* blood pressure readings. Intra-arterial blood pressure readings do not necessarily agree with auscultatory readings. In fact, it is common for the diastolic pressure determined intra-arterially to be 7-10 mmHg lower than an auscultatory reading.

- Blood pressure can vary between the left and right arm by as much as 20 mmHg on some patients. When comparing the Welch Allyn measurement to a manual reading on an opposite arm it is important to repeat the comparison after switching arms and then compare the average of both readings. This will help to eliminate the difference between the two arms.

- A person's blood pressure is continuously changing in reaction to their environment and physical state. Posture changes, conversation and other influences can easily cause a person's blood pressure to change dramatically. When comparing the Welch Allyn measurement to a subsequent manual reading on the same arm it is important to enure that the person's blood pressure has stabilized. To determine this, it is best to take a manual reading before and after the Welch Allyn reading. A stable subject should not have a change in systolic or diastolic of more than 5 mmHg.

- It is very important that both of the subject's arm remain in the same relative location throughout the test. One inch of elevation change will result in 1.8 mmHg change in the systolic and diastolic pressures.

- Proper cuff sizing is important. Using a cuff that is too small or too large will result in inaccurate blood pressure readings.

TEMPERATURE ERROR CODE CORRECTION

1. Turn the unit off.
2. Hold down the “Start” button as you turn the unit back on. Continue to hold down the “Start” button until the alarm signals dissipate.
3. Make sure that you see either a “2.4” or a “24” in the temperature window.
4. Press the “Review” button and you should see “CAL” in the systolic window.
5. Press the “Review” button again and you should see “BAT” in the systolic window.
6. Press the “Review” button again and make sure that three dashes (---) appear in the temperature window.
7. Once this has been confirmed, press the “Review” button until you see “2.4” or “24” in the temperature window. Make sure the probe is in the housing.
8. Turn the unit off, then turn the unit on allowing it to boot up into its normal mode.
9. Allow the “PC” to disappear from the temperature window.
10. Remove the probe from the housing. You should see a “1888” then “ORL” appear. If not, contact your local service department.

3.7 TROUBLE SHOOTING GUIDE

Symptom	Possible Cause	Explanations and Corrective Action
1. Inaccurate Blood Pressure Readings	**Incorrect Cuff Size**	**Determine correct cuff size:** • use reference markings on cuff • measure patient's arm circumference midway between elbow and shoulder (see page 42 of Operator's Manual to select correct cuff size).
	Patient's Arm Position	**Ensure Patient's arm is at heart level.**
Please note: Differences '10mmhg should be considered 'normal and will occur for a number of reasons including intrapatient BP variability, observer hearing differences, and auscultatory deflation rate.	**Arm Movement During blood pressure cycle**	**Keep arm still during blood pressure cycle:** • movement may cause inaccuracies from artifact
	Blood Pressure taken over clothing	**Blood Pressure should be taken on a bare arm.**
	Arrhythmia	**Check for regularity of heart rate: (palpate pulse or check monitor)** • moderate to severe heart rate irregularities may make blood pressure difficult to measure.
	Incorrect Reference	**Use 4th Korotkoff sound to determine diastolic blood pressure.** • Many listener's incorrectly equate diastolic blood pressure with the disappearance of sound. The Vital Signs Monitor was developed using the 4th sound, as recommended by the American Heart Association.
	Change in blood pressure from auscultatory reading to Vital Signs Monitor reading	**Deflate cuff no faster than 3mmhg per second:** • One of the major sources of error in auscultatory blood pressure measurement is deflating the cuff to quickly. The American Heart Association recommends deflation no faster than 3mmhg per second. **Only use a spygnomometer that is known to be in calibration:** • Blood pressure taken with un-calibrated sphygmomanometer may be very inaccurate. **Check blood pressure immediately prior to Vital Signs Monitor Reading**
	Poor auscultatory sound recognition by observer	**Use higher quality stethoscope** **Have a different observer check patient's blood pressure**

3.7 TROUBLE SHOOTING GUIDE

Sympton	Possible Cause	Explanations and Corrective Action
2. Cuff Inflation & Deflation With No Blood Pressure Reading Displayed. **(or error code in display)**	**Leak in pneumatic system**	**Make sure all cuff attachments are tight.** **Carefully check for tubing leaks on blood pressure cuff and tubing attachment to monitor.**
	Arm Movement During Cycle	**Keep arm still during blood pressure cycle:** • movement may cause inaccuracies from artifact.
	Tubing Movement Artifact	**Do not contact tubing during blood pressure cycle** • movement may cause inaccuracies from artifact.
3. No Cuff Inflation	**Connections from monitor to cuff loose**	**Check all connections. (Do not over tighten).**
4. Temperature Malfunction • Error code displayed	**Broken Probe**	**Replace Probe** **Consult Technical Manual** **Notify Biomedical department or Welch Allyn Customer Service (800) 854-2904**
• Low Temperature Readings	**Improper Probe Placement**	**Wait for display window to read ORL before placing probe** **Place probe in most posterior sublingual pocket**
• No Temperature Displayed	**Probe not Replaced**	**Notify biomedical or Welch Allyn Customer Service.** **Replace probe in holder prior to taking another temperature.**
5. SPO2 Malfunction • Sensor in place but no SPO2 on display	**Improperly attached sensor**	**insert the patient's finger completely into sensor**
	Cable incorrectly plugged into monitor	**Be sure sensor cable is correctly plugged into monitor**
	SPO2 disabled	**Be sure SPO2 is enabled with Mode button -** (SPO2 light will be off when disabled)
• Inaccurate SPO2 Reading	**Incorrect Sensor**	**Assure that correct manufacturers sensor is in use -** they are not interchangeable

3.7 TROUBLE SHOOTING GUIDE

Sympton	Possible Cause	Explanations and Corrective Action
6. Printer Malfunction	**Paper will not advance**	**Consult Technical Manual** **Notify Biomedical or Welch Allyn Customer Service.**
7. Monitor Will Not Power Up	**Low Battery**	**Check connections between monitor and transformer and wall receptacle.**
	Monitor not plugged in	**Unplug unit from wall receptacle and check for breaks in cord. if connections secure and power supply is intact.** **Notify Biomedical Department or Welch Allyn Customer Service.**
8. Cuff Too Tight (over inflation)	**Pressure Preset too high**	**Check pressure preset setting:** • Unless patient has underlying systolic hyper-tension, set pressure preset at 160mmhg. (If Systolic blood pressure is greater than 'pressure preset, monitor will automatically 'increase an additional 40mmhg).
9. Cuff Popping Off	**Inappropriate size cuff**	**Determine cuff size with the cuff markings or refer to chart in Operator's Manual for determining cuff size.** • If cuff continues to pop off, notify Biomedical Department or Welch Allyn Customer Service.
	Cuff applied inside out	**Re apply cuff:** • make sure smooth surface of velcro is facing patients arm
10. Cuff Deflating Too Slowly	**Normal Operation**	**Deflate cuff no faster than 3mmhg per second:** • One of the major sources of error in ausculta-tory blood pressure measurement is deflating the cuff too quickly. The American Heart Association recommends deflation no faster than 3mmhg per second.
	Pressure Preset too high	**Check pressure preset setting**

SECTION 4:

Major Component Removal

4.1 Front Housing

ABSTRACT:

4.1 Opening up the ***front housing*** is necessary when replacing the main fuse. Complete removal of the front housing is necessary to replace the main printed circuit board (PCB), display board, switch pad and other components.

4.1.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, **remove** unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.1.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door. **Use T112918 with the #4 Phillips bit.**
__ **Remove** battery door.

4.1.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.1.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.1.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board. Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.
__ **Disconnect** the temperature connector plug from the temperature PCB.
__ **Remove** the main PCB by removing the 7 torx screws with T112917 and the torx t8 bit. Disconnect the flex cable that connects to the display PCB. **Remove** the main PCB.
__ **Remove** the 7 gray spacers.
__ **Remove** the display PCB from front housing.

The front housing is now free.

Replace the front housing by assembling in reverse order following these special instructions.

4.1.6 Reconnecting the connectors.

__ **Reconnect** the green wire 2-pin connector to the two male pins on the main board with the wire contact (away from) the temperature board.

__ **Carefully** align all other connectors and flex circuits in mating connectors.

Reassemble in reverse order. No special techniques required.

4.1.7 Verification of repair.

__ **Switch** the unit to ‘on’ and **perform** a full functional check.

4.2 Main Fuse f-1

ABSTRACT:

4.2 Removing and replacing the ***main fuse f1. (t5ah*** 250v) pn114s586.
One possible cause of failure to 'power up' is an open fuse (blown fuse). Before replacing the fuse with a good one, troubleshoot the unit for an existing short circuit or high current drain. Follow the procedure as shown below.
The front housing only has to be pulled away slightly from the rear housing to allow your fingers to reach the main fuse.

4.2.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.2.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.2.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.2.4 Opening Front Housing

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 with the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.2.5 Gaining access to fuse F1.

__ **Open** 4 unit far enough to gain access to the fuse.
__ **Disconnect** the top two red connectors to make opening easier.
Do not force the housings apart as this could damage components, board, wires or connectors.
__ **Insert** plastic trimmer adjustment tool under fuse and pry fuse out of holder. (use a trimmer adjustment screwdriver or equivalent or any insulated tool that will fit between the fuse holder body and the fuse body enabling you to pry the fuse out of the holder.
__ **Verify** that the fuse you removed was in fact open. **Check** with dvm.
__ If fuse is open (blown), **troubleshoot** to determine cause of the overcurrent condition. **See** item 4.2.6 below.
__ If fuse is closed (good), troubleshoot to determine other causes of failure of unit to 'power up'.

4.2.6 General procedure for testing for short circuit.

__ **Remove** battery from unit. (this should have been done)
__ **Remove** blown fuse from main PCB.
__ **Attach** jumper wires between two sides of fuse block.
__ **Connect** ohmmeter to red and black power input wires inside of the battery compartment.
__ Resistance should not be less than infinity or ol (open leads).
__ In case of dead short, **continue** to troubleshoot for short condition.

4.2.7 Installing fuse f1.

__ **Press** replacement fuse service part 114s586 securely into fuse holder.
__ **Reconnect** any plugs which were unplugged to gain access to the fuse block.

Reassemble in reverse order, no special techniques required.

4.2.8 Verification of repair.

__ **Switch** the unit to ‘on’ and **perform** a full functional check.

4.3 Main Printed Circuit Board (main PCB)

ABSTRACT:

4.3 Removing and replacing the ***main PCB*** requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors. The small temperature board will be removed in the process. It can be swapped over to the replacement main PCB. It is held on by two of the seven torx fasteners.

4.3.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.3.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.3.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.3.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.3.5 Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.3.6 Removal of temperature board from main PCB.

__ **Unscrew** two torx fasteners with T112917 with the torx t8 bit and lift the temperature board up and set it aside.

4.3.7 Separating the main PCB from the display PCB.

__ **Unplug** the main PCB to display PCB flex circuit.
__ **Remove** five (5) remaining torx fasteners with T112917 with the torx t8 bit and lift the main PCB out of the front housing. Watch for the 7 gray spacers.

Reassemble in reverse order with attention to the following details

4.3.8 Attaching the temperature board to the main PCB.

__ **Make sure** all of the seven (7) gray plastic board spacers are in place before placing the main PCB over the display PCB.

__ **Insert** and tighten five of the last fasteners that were removed.

__ **Place** the temperature board onto the main PCB and secure it with two torx fasteners.

4.3.9 **Reconnect** the temperature board connector to the main PCB socket.

Reassemble in reverse order

4.3.10 Verification of repair.

__ **When completely assembled, switch** the unit to 'on' and **perform** a full functional check, including recalibration.

4.4 DC to DC Converter (SpO_2 Units Only)

ABSTRACT:

4.4 To replace the ***DC to DC converter***, it is necessary to remove the main PCB.

4.4.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.4.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.4.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.4.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.4.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.4.6 Separating the main PCB from the display PCB.

__ **Unplug** the main PCB to display PCB flex circuit.

__ **Remove** seven (7) torx fasteners with T112917 with the torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.

4.4.7 Replacing the DC to DC converter from the main PCB.

__ **Peel** off the rtv surrounding the old converter.

__ **De-solder** the old converter.

__ **Clear** the 8 holes out with a thru-hole solder sucker.

__ **Install** a replacement converter as per figure 4.4.7 below.

__ **Secure** with rtv (innerbond i-45) on all four sides.

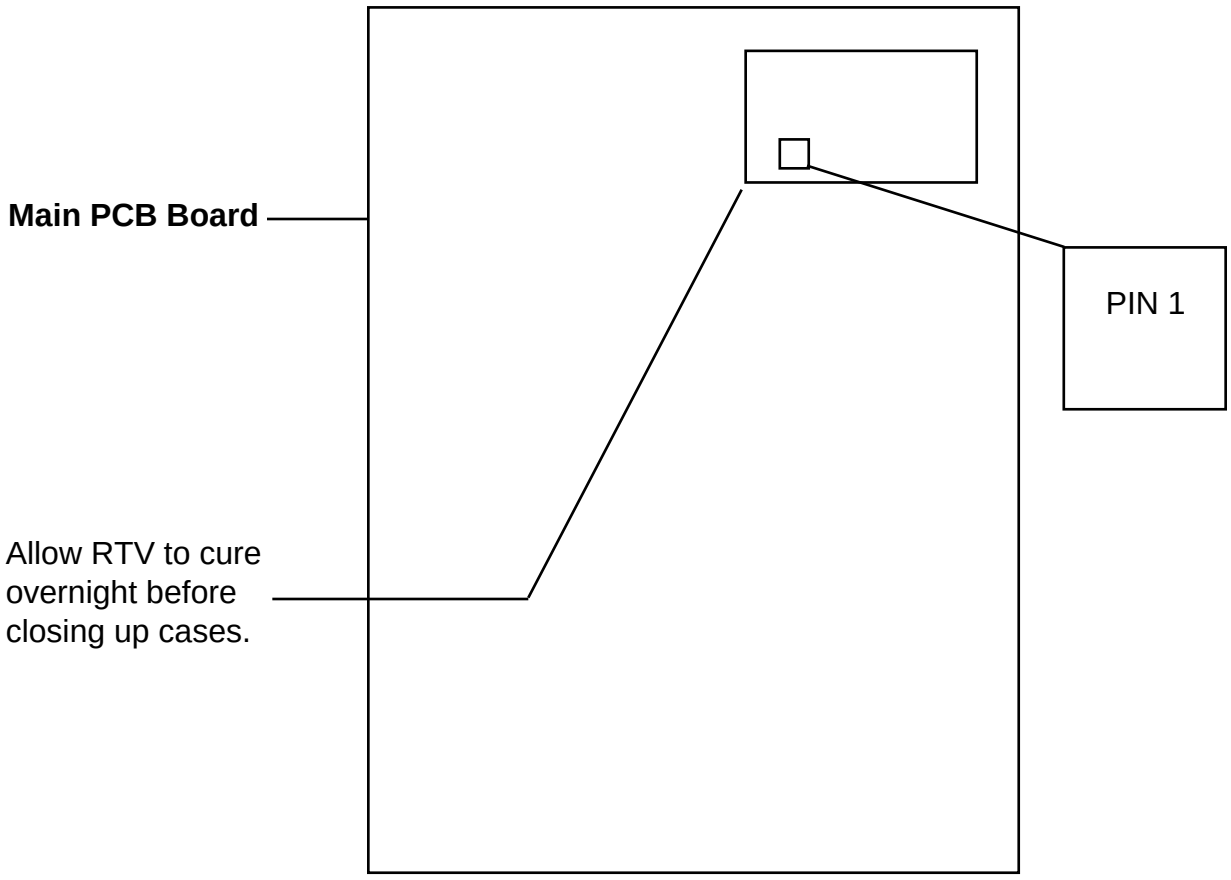


Figure 4.4.7

Reassemble in reverse order, no special techniques required.

4.4.8 Verification of repair.

__ **When completely assembled, switch the unit to on and do a full functional check, including calibration.**

4.5 Pressure Transducer On Main PCB

ABSTRACT:

4.5 To replace the ***pressure transducer*** on the main PCB, it is necessary to remove the main PCB.

4.5.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.5.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.5.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.5.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.5.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.5.6 Separating the main PCB from the display PCB.

__ **Unplug** the main PCB to display PCB flex circuit.
__ **Remove** seven (7) torx fasteners with T112918 with the torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.
__ **Do not lose** the 7 gray spacers.

4.5.7 Replacing the pressure transducer on the main PCB.

__ **De-solder** the old transducer.
__ **Clear** the 6 holes out with a thru-hole solder sucker.
__ **Install** a replacement pressure transducer per figure 4.5.7 below.

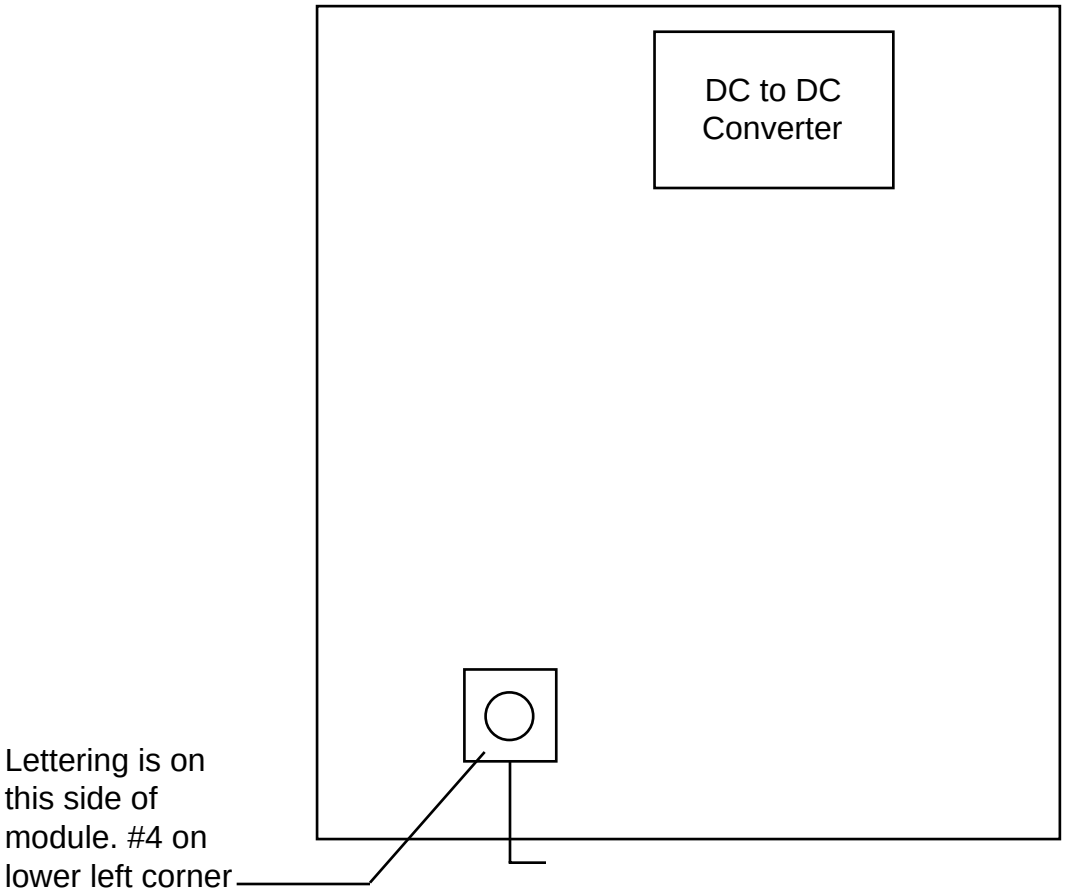


Figure 5.5.7

Reassemble in reverse order, no special techniques required.

4.5.8 Verification of repair.

__ **When completely assembled, switch** the unit to 'on' and **perform** a full functional check, including recalibration.

4.6 Display Printed Circuit Board (Display PCB)

ABSTRACT:

4.6 Removing and replacing the ***display PCB*** requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors, remove the temperature PCB and main PCB.

4.6.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.6.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.6.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.6.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.6.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.6.6 Separating the main PCB from the display PCB.

__ **Unplug** the main PCB to display PCB flex circuit.

__ **Remove** seven (7) torx fasteners with T112918 torx t8 bit and lift the main PCB and the temperature PCB out of the front housing.

__ **Remove** the seven (7) gray board spacers as they will be reused.

4.6.7 Removing the display PCB from the front housing.

__ Gently **lift** the display board out of the front housing.
Be careful not to damage the exposed LED's.

Reassemble in reverse order with attention to the following details.

4.6.8 Place display PCB into front housing.

__ **Seat** the display PCB over screw bosses.

__ **Place** 7 spacers over front housing bosses projecting through PCB and seat them securely against the surface of the PCB.

4.6.9 Attaching main PCB to the display PCB and front housing.

__ **Use** all seven gray spacers to prevent damage to the boards.

__ Gently **lay** the main PCB onto the spacers (component side up) so that all of the holes line up.

__ **Insert** and **tighten** five (5) torx fasteners with T112917 with the torx t8 bit.

4.6.10 Attaching the temperature board (option).

__ **Align** the temperature board so that the component side faces towards the center of the unit.

Continue reassembly in reverse order of disassembly.

4.6.11 Verification of repair.

__ **When completely assembled, switch** the unit to 'on' and **perform** a full functional check, including recalibration.

4.7 Key Pad (Switch Array)

ABSTRACT:

4.7 Removing and replacing the ***key pad*** requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors, and remove the main and display PCB's from the front housing. If the key pad is being removed for suspected moisture or contamination, replace it with a new one once the PCB is cleaned.

4.7.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.7.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.7.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.7.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.7.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.7.6 Separating the main PCB from the display PCB.

__ **Unplug** the main PCB to display PCB flex circuit.
__ **Remove** all seven (7) torx fasteners with T112918 with the torx t8 bit and lift the main PCB and temperature PCB out of the front housing.
__ **Remove** the seven (7) gray board spacers as they will be reused.

4.7.7 Removing the display PCB from the front housing.

__ Gently **lift** the display board out of the front housing. Be careful not to damage the exposed led's.

4.7.8 Removing the key pad.

__ Gently **peel** the old key pad away from the PCB.

__ **Inspect** the PCB for contamination and clean accordingly with alcohol. Allow the alcohol to evaporate for one minute then blow off lint. From this point on, do not touch contact surfaces.

Reassemble in reverse order with attention to the following details.

4.7.9 Attach new key pad to the display PCB..

__ **Lay** flexible key pad over PCB and exactly align protrusions over holes in PCB.

__ **Press** protrusions into holes with tool T-112067. Be careful not to tear keypad.

4.7.10 Place display PCB into front housing.

__ **Seat** the display PCB over screw bosses.

__ **Place** 7 spacers over front housing bosses projecting through PCB and seat them securely against the surface of the PCB.

4.7.11 Attaching main PCB to the display PCB and front housing.

__ **Use** all seven gray spacers to prevent damage to the boards.

__ Gently **lay** the main PCB onto the spacers (component side up) so that all of the holes line up.

__ **Insert** and **tighten** torx fasteners with T112917 with the torx t8 bit.

4.7.12 Attaching the temperature board (option).

__ **Align** the temperature board so that the component side faces towards the center of the unit.

Continue reassembly in reverse order of disassembly.

4.7.13 Verification of repair.

__ **When completely assembled, switch** the unit to 'on' and **perform** a full functional check, including recalibration.

4.8 Temperature PCB

ABSTRACT:

4.8 Removing and replacing the ***temperature PCB*** requires that you remove the battery, split the cases, unplug one pneumatic line and electrical connectors. The small temperature board can be removed by unscrewing two Phillips head screws which hold the board to the two small "l" brackets. it is not necessary to remove the brackets from the main PCB.

4.8.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.8.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.8.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.8.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.8.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free from the rear housing

4.8.6 Removal of temperature board from "l" brackets on the main PCB.

__ **Disconnect connector from main board socket.**
__ **Disconnect** the temperature connector cable from the temperature PCB.
__ **Unscrew** two torx fasteners with T112917 with the torx t8 bit and lift the temperature board up.

The temperature board is now free from the main PCB.

Reassemble in reverse order with attention to the following details.

4.8.7 Attaching the temperature board when main PCB was not removed..

__ **Place** a spacer on each Phillips head screw.
__ **Insert** screw through board
__ **Place** another spacer on each screw
__ **Thread** screw into “l” bracket part way.
__ **Apply** Locktite 222 on the end of the screw and thread all the way into the bracket.

4.8.8 **Reconnect** the temperature connector to main PCB socket. **Reconnect** the temperature connector cable to the temperature PCB.

Reassemble in reverse order

4.8.9 Verification of repair.

__ When completely assembled**,** switch the unit to ‘on’ and perform a full functional check of the temperature function.

4.9 Specific Oxygen Board (NONIN SpO_2 PCB)

ABSTRACT:

4.9 Removing and replacing the ***Nonin SpO_2 PCB*** requires that you remove the battery, and remove the front housing.

4.9.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.9.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.9.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.9.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.9.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free from the rear housing.

4.9.6 Removing the Nonin SpO_2 PCB.

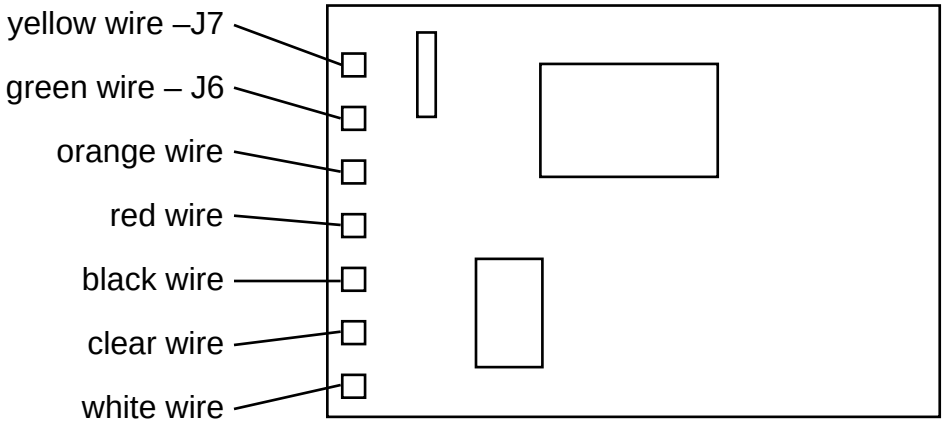
__ **Turn** unit on its back and unscrew two torx screws from the board.
Use T112917 with the torx t8 bit.
__ **Disconnect** tube from bottom of valve.
__ **Disconnect** tube from pressure outlet fitting.
__ **Slide** board out of well.

4.9.7 Remove wires from board.

__ **Remove** rtv from the back side of seven wire solder connections shown below in figure 4.9.7

__ **Unsolder** wires from board as per figure 4.9.7 below.

__ **Remove** solder from wires to prepare for new board.



4.9.8 Checking wire connections by pin-out process.

__ Each wire will terminate at a specific pin position on the SpO_2 jack. Therefore, **reconfirm** that all connections are correct by pinning out your work. Use figure 4.9.8 to verify connections.

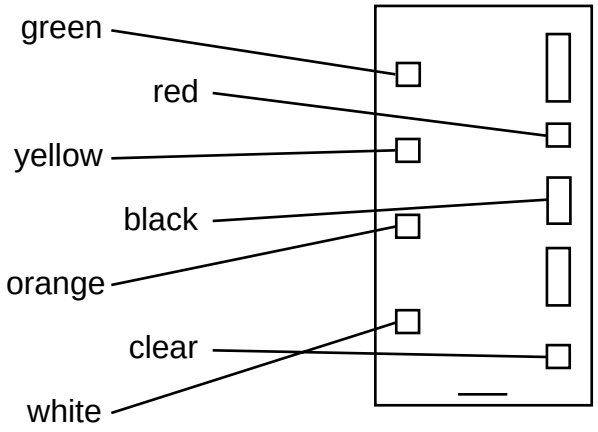


Figure 4.9.8 SpO_2 jack, wire side

4.9.9 Replacing the SpO_2 board.

__ **Connect** wires to locations as shown above.

__ **Cover** bottoms of connections with 376e108 (G.E. gray rtv #167, electronic adhesive sealant)

Reassemble in reverse order of disassembly.

4.9.10 Verification of repair.

__ When completely assembled, switch the unit to ‘on’ and perform a full functional check of the SpO_2 function.

4.10 Specific Oxygen Board (NELLCOR SpO_2 PCB)

ABSTRACT:

4.10 Removing and replacing the ***Nellcor SpO_2 PCB*** requires that you remove the battery, and remove the front housing.

4.10.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole-mounted, **remove** unit from the pole.
__ If the unit is wall-mounted, **remove** unit from the wall.
__ If the unit is free-standing, **turn** the back towards you.

4.10.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.10.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.10.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.10.5 Disconnection of connectors.

__ **Disconnect** one (1) four-pin connector and one (1) seven-pin connector from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free from the rear housing.

4.10.6 Removing the Nellcor SpO_2 PCB.

__ **Turn** unit on its back and unscrew two torx screws from the board and lift blue wire.
Use T112917 with the torx T8 bit.
__ **Disconnect** tube from bottom of valve.
__ **Disconnect** tube from pressure outlet fitting.
__ **Remove** two (2) screws from valve and lift valve.
Use T112917 with the torx T8 bit.
__ **Lift** Nellcor SpO_2 PCB from well.

4.10.7 Removing wires from board

__ **Unplug** the connector for the main PCB terminator by using a flat head screw driver and gently pry upwards on the connector.

__ **Unplug** the connector for the outside interface by simply pulling back on the connector.

The SpO_2 PCB has been removed from the rear housing.

4.10.8 Replacing the SpO_2 PCB

__ **Connect** the main PCB terminator cable connector to its proper port on the Nellcor SpO_2 PCB.

__ **Connect** the outside interface cable connector to its proper port on the Nellcor SpO_2 PCB.

Reassemble in reverse order of disassembly.

4.10.9 Verification of repair.

__ **When completely assembled, switch** the unit to 'on' and **perform** a full functional check of the SpO_2 function.

4.11 Pump/ Motor Assembly

ABSTRACT:

4.11 Removing and replacing the ***pump motor assembly*** requires the removal of the battery and the front housing. The replacement motor comes with an attached wire tie mounting pad.

4.11.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ if the unit is free standing, **turn** the back towards you.

4.11.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.11.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.11.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.11.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.11.6 Removing the old pump/motor.

__ **Remove** the tubing from the motor. This can also be done after the motor is more accessible when it is out of the rear housing.
__ **Place** a flat blade screwdriver under the wire tie pad which holds motor in place.
__ Gently **remove** the motor from the rear housing.
__ **Unsolder** the orange and white wires from the motor terminals.
__ **Remove** any residue from the old pad with a flat blade screwdriver.

4.11.7 Installing a replacement pump/motor assembly.

__ **Clean** the pad mounting area with alcohol prior to soldering. This will allow time for the alcohol to evaporate.

__ **Solder** the orange wire to the plus (+) terminal of the motor.

__ **Solder** the white wire to the negative (-) terminal of the motor.

Be careful in this next step. Do not attach the pump/motor assembly to the rear housing until you are sure it is positioned properly. Keep in mind that the wires are intended to be on the left side of the pump/motor assembly, and that the motor end must not be resting against the back wall of the rear housing.

__ **Remove** the protective paper from the pad and place the pump motor assembly into the rear housing so that the end of the pump is even with the platform it sits on. This assures that the motor end will not be in contact with the back wall of the rear housing. Be careful to keep the wires away from the adhesive pad. Make sure that the other wires in the area are on the left side of the motor.

__ When everything is aligned, **attach** the pump/motor assembly to the rear housing by pressing the adhesive pad against the platform.

__ **Connect** the tube to the barb fitting of the pump.

Reassemble in reverse order of disassembly.

4.11.8 Verification of repair.

__ When completely assembled, switch the unit to ‘on’ and perform a full functional check and re-calibration.

4.12 MPL-503 Pressure Switch

ABSTRACT:

4.12 Removing and replacing the ***MPL-503 pressure switch*** requires the removal of the battery and the front housing. The replacement pressure switch attaches with two torx fasteners. Two spade connectors make up the electrical connections. One tube connects to the switch.

4.12.1 preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.12.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.12.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.12.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.12.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.12.6 Removing the old pressure switch.

__ **Remove** the tubing from the switch.
__ **Unscrew** two torx fasteners. Use T112917 with the t8 torx bit.
__ Gently **remove** the switch from the rear housing.
__ **Disconnect** the two spade connectors from the switch.

4.12.7 Installing a replacement pressure switch. See figure 4.11.7 below.

__ **Connect** the green wire spade connector to the left terminal.
__ **Connect** the yellow wire spade connector to the right terminal.
__ **Replace** two torx fasteners using T112917 with torx t8 bit.
__ **Connect** the tube to the left barb connector of the switch.

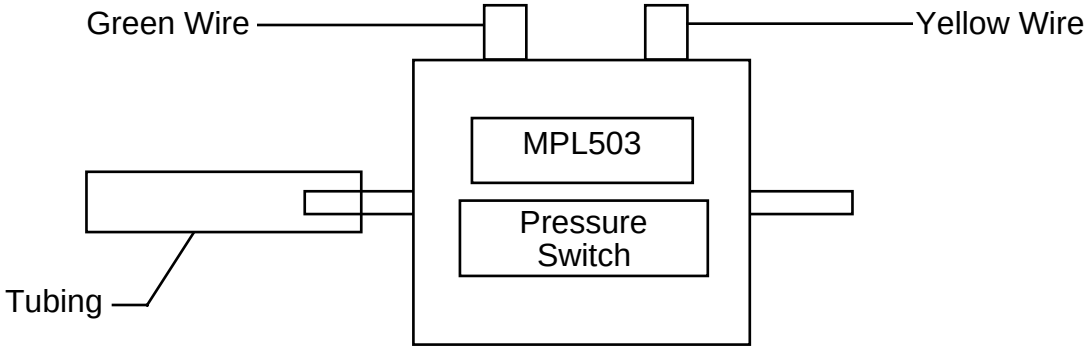


Figure 4.11.7 switch connections

Reassemble in reverse order of disassembly.

4.12.8 Verification of repair.

__ When completely assembled, switch the unit to ‘on’ and perform a full functional check and re-calibration.

4.13 Valve (Pneutronics)

ABSTRACT:

4.13 Removing and replacing the ***Pneutronics valve*** requires the removal of the battery and the front housing. The replacement valve attaches with two torx fasteners. Two spade connectors make up the electrical connections. One tube connects to the valve.

4.13.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.13.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
U**se T112918 with the #4 Phillips bit.**
__ **Remove** battery door.

4.13.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.13.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.13.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing

4.13.6 Removing the valve.

__ **Remove** the tubing from the valve.
__ **Unscrew** two torx fasteners. Use T112917 with the t8 torx bit.
__ Gently r**emove** the valve from the rear housing.
__ **Disconnect** the two spade connectors from the valve.

4.13.7 Installing a replacement valve. See figure 4.12.7 below.

__ **Connect** the green wire spade connector to the left terminal.
__ **Connect** the dark brown wire spade connector to the right terminal.
__ **Replace** two torx fasteners using T112917 with torx t8 bit.
__ **Connect** the tube to the barb connector of the valve.

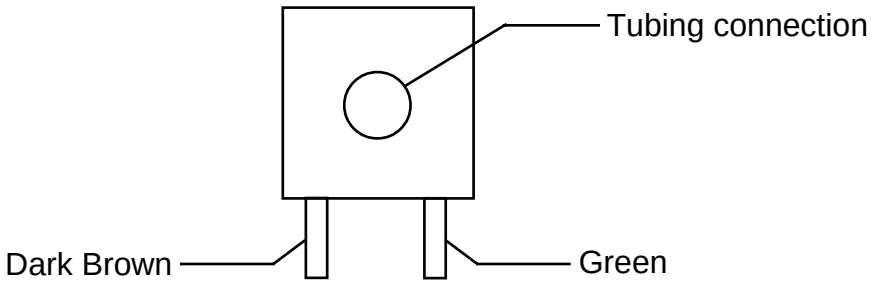


Figure 4.12.7 bottom view of valve (pneutronics)

Reassemble in reverse order with attention to the following details.

4.13.8 Placement of wires during reassembly.

__ **Make sure** the four pin wire harness is routed over and around the valve, and not underneath it.
__ **Make sure** that no wires are pinched underneath the valve.
__ **Make sure** that the dark brown and green wires are pushed down into the housing to eliminate any interference with the gears of the printer.

4.13.9 Verification of repair.

__ When completely assembled, switch the unit to ‘on’ and perform a full functional check and re-calibration.

4.14 Printer/Printer PCB/Keypad

ABSTRACT:

4.14 Removing and replacing the ***printer /PCB assembly*** requires the removal of the battery and the front housing. The ***keypad array*** can cleaned and or replaced easily ***without removing the front housing***. The printer and the printer PCB are soldered together and are replaced as a unit.

4.14.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.14.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.14.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.14.4 Opening front housing.

__ **Position** unit so the front panel is facing down.
__ **Remove** six (6) Phillips screws with T112918 and the #6 Phillips bit.
__ **Carefully separate** the front and rear housings.

4.14.5 Disconnection of connectors.

__ **Disconnect** two (2) four-pin connectors (red) from top of main board to relieve strain.
__ **Unplug** main 14-pin connector (red) from center of main PCB.
__ **Disconnect** pressure line (1/16" tubing) from transducer.
__ **Disconnect** the printer flex circuit from the main board.
__ **Disconnect** 7-pin connector coming from the temperature connector PCB to the temperature PCB.
__ **Disconnect** the green wire 2-pin connector from the main board.
Note the orientation of the green wire. It is towards the center of the main PCB, or away from the temperature board.

The front housing is now free of the rear housing.

4.14.6 Remove/clean keypad array.

__ **Remove** the paper cover.
__ **Remove** the paper roll
__ **Unscrew** two torx fasteners. Use T112917 with the t8 torx bit.
__ Gently **slide** the printer housing cover towards you and disengage the two screw tabs from the rear housing.
__ Very gently **roll** the printer housing cover up and away from you to gain access to the flex circuits underneath.
__ **Disconnect** the white flex circuit connector. (Note the orientation of the blue color on the connector end of the flex circuit. It is facing away from you in while you are disconnecting and reconnecting (later during reassembly).
__ Carefully **unscrew** the five (5) torx fasteners with insulators. Use T112917 with the torx t8 bit. Be careful not to tear the copper shield from its connecting wire.
__ **Lift up** the copper shield and remove the keypad array.

4.14.7 Removing the printer /PCB assembly.

__ **Insert** a flat blade screwdriver under the printer and pry loose the two doublesided foam tape fasteners.
__ **Slide** the printer out of the rear housing.
__ **Pass** the printed circuit board through the opening in the rear housing and completely remove the printer and printer PCB assembly.

Reassemble in reverse order with attention to the following details.

4.14.8 Placement of printer in rear housing.

__ When attaching the printer to the rear housing, **make sure** it is positioned all the way into the recess.

4.14.9 Attaching printer PCB to printer cover.

__ Carefully **place** the PCB into the cover so that the buttons protrude through the cover. Align the holes in the board with the standoffs on the cover and insert the five (5) screws with plastic insulators.

4.14.10 Verification of repair.

__ When completely assembled, **switch** the unit to ‘on’ and perform a full functional check of printer. Re-calibrate**.**

4.15 6 Volt Battery

ABSTRACT:

4.15 Removing and replacing the battery cover, battery. Occasionally it may be necessary to remove or replace the internal sealed lead battery (rechargeable battery) pn72700. (6v,4ah/20hr)

CAUTION:
- Do not short circuit battery!
- Do not charge in a sealed container
- To avoid burn, if contact is made with electrolyte (acid) flush with water immediately!

WARNING:
- Insert battery only as shown.
- Failure to observe correct polarity could cause damage to unit.
- When it is necessary to replace the battery, use the approved no.5200-84 replacement battery only.
- Recycle used batteries.
- Make sure that replacement batteries are fully charged before returning unit to customer.

4.15.1 Preparing the unit for disassembly.

__ **Turn** unit off and **disconnect** AC power cord from the unit.
__ **Disconnect** all accessories from the unit.
__ If the unit is pole mounted, remove unit from the pole.
__ If the unit is wall mounted, **remove** unit from the wall.
__ If the unit is free standing, **turn** the back towards you.

4.15.2 Battery cover removal.

__ **Remove** four (4) Phillips head screws from the battery door.
Use T112918 with the #4 Phillips bit.
__ **Remove** battery door.

4.15.3 Battery removal from battery compartment.

__ **Remove** the battery out of the compartment by turning the unit upside down and shaking until battery begins to slide out.
__ **Disconnect** the two (2) connectors.
__ (If the battery is to be discarded, **comply** with all environmental regulations pertaining to battery disposal.)

4.15.4 Battery installation (new or same battery).

__ **Position** battery near battery compartment so that the connector wires are within reach of the battery terminals.
__ **Attach** battery connectors to the battery as shown in diagram inside of battery compartment. (Connectors are polarized to prevent reverse polarity damage to the unit. **Do not cut or remove** positive battery connector from battery terminal.

4.15.5 Positioning battery strap.

__ **Position** the battery strap under the battery and **slide** the battery into the battery compartment as far as it will go.
__ **Fold** the end of the battery strap over the battery.

4.15.6 Replacing the battery door.

__ **Place** the battery door over the opening of the battery compartment so that the small ends of the keyhole slots are facing up.

__ **Attach** battery door with the four (4) Phillips screws.

4.15.7 Charging battery. (The unit may be used while new battery is charging.)

__ **Connect** AC power transformer to the monitor and allow the new battery to charge for approximately sixteen (16) hours.

SECTION 5:

Test Procedures

5.1 Calibration Test

ABSTRACT: The following is the test procedures for the WELCH ALLYN VITAL SIGNS MONITOR. We set this procedure up so that you can start at section 5.1 and go straight through the procedure or you can skip around. However, you must do all of the test called out in this section before a unit can be returned to field service.

NOTES:
A. The word “unit” in this text refers to the WELCH ALLYN VITAL SIGNS MONITOR.
B. ***Menu|Choice*** represents menu commands. Rather than use the phrase “choose the Exit command from the File menu.”

1. **Connect** the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station (see Section 2, Figure 2.2.1). Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service
   port connector to the computer. Start the computer program by double clicking on its program icon.

2. **Remove** the battery and hook unit up to the power supply and the digital voltage meter. Power supply should be set at 6.5Vdc.

3. **Turn on the unit** and in the program choose ***Unit|Information***. Confirm that the information displayed on the screen matches that of the unit under test. Note : If the software returns an ERROR message, check the communications link, and re-send the command. If the communications return another error close the information dialog box then select ***Tools|Options*** and check that the correct communications port is selected. Place the unit into the “Detailed Test” mode by holding down the “start” and “cancel” buttons as power is applied.

4. **Observe** the unit. **Verify** that the software versions displayed on the LED displays meet the specifications called out in the Repair Test Specifications document.

5. **Press** the review button on the unit. The systolic window should read “CAL.”

6. **Attach** a pneumatic clamp to the 100cc and the 250cc volume, remove the clamp from the 500cc volume.

7. **Choose** ***Test|Calibration***. The dialog box will display the unit manometer reading, unit battery reading, valve and pump status.

Note : Use Start button to close valve, and hand bulb to set the pressures.

8. **Verify** that the unit is within calibration specification at all the following target pressures: 0, 50, 100, 150, 250, and 285 mmHg. All target pressures have a tolerance of +/- 5 mmHg. Specification are found in the Repair Test Specifications document.

9. **Press** the “review” button until the systolic window reads “bat.”

10. **Set** the power supply to 5.5 +.05,-0 Vdc (5.5 to 6.0 Vdc). Verify that the voltage reading of the unit meets specification called out in the Repair Test Specification document. Return the power supply to 6.5 Vdc upon completion of this test.

11 **Press** Close to exit from the “Test Calibration” dialog box.

5.2 Current Tests

1. **Connect** the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Turn unit off unit then re-power unit allowing the unit to boot up into its normal mode.

3. Click on ***Test|Current Levels***. Check the following current levels:
   a. Blank
   b. Idle
   c. Valve
   d. Pump
   e. SpO_2
   f. Temperature

4. Verify these currents meet the specifications called out in the Repair Test Specification document.

5. Press Close button to exit dialog box.

5.3 Noise Levels

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Click on ***Test|Noise Levels***.

3. Press Test button to retrieve the units internal pressure channel noise level. Verify that the noise level meets the specification called out in the Repair Test Specification document.

5.4 Button Test

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Choose ***Test|Button Test***. Press each button and ensure that the computer acknowledges it, via the "Button Pressed" display. Each button should also cause the units display to change to one of the settings noted below.

KEY	RESPONSE
Power	0
Start	1
Cancel	2
Review	3
Auto	4
Silence	5
Adjust	6
Select	7
Pressure Preset	8
Mode	9
Form Feed	F
Print	P
Invalid response	E

F,P - When printer option is installed
E - Usually multiple keys pressed.

3. Press Close button to exit from dialog box.

5.5 Print Quality

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Choose ***Test|Print Quality***. Choose “test pattern 1.” The printer will print out a pattern of large and small ASCII characters. Verify the quality of the printer output. Once test 1 is complete, choose “test pattern 2.” The printer will print out a solid gray field. Verify the quality of the printer output.

Note : This option will only work when the printer option is installed.

5.6 Pneumatics Tests

1. Connect the WELCH ALLYN VITAL SIGNS MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place unit into the “detailed test” mode. Do this by holding down the start and cancel buttons as the unit is powered up. Clamp off the 500cc and 250cc volumes, leaving the 100cc volume connected to the unit. Press the “review button” until “CAL” appears. Press the Start button to close the units valve. Using the hand bulb inflate the unit to the first test pressure, 250mmHg +/- 5mmHg (245 to 255 mmHg), and wait 15 seconds to stabilize.

3. Select ***Test|Pneumatic***, and then the “Leak Test” option. Press the Test button to perform the first leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the “Pressure” box. Verify that the leak rate meets the specification called out in the Repair Test Specification document.

   Press the Cancel button to open the unit valve and release the pressure.

   Note : The software will verify that the pressure is 250mmHg +/- 5mmHg, before it will begin a leak test.

4. Open the valve on the bulb and release pressure to the second test pressure, 50mmHg +/- 5mmHg (45 to 55 mmHg), and wait 15 seconds to stabilize.

   Press the Test button to perform the second leak test. The test lasts 15 seconds. Once the test is complete the pressure change is displayed in the “Pressure” box. Verify that the leak rate meets the specification called out in the Repair Test Specification document.

5. Press the Cancel button to open the unit valve and release the pressure.

   Note : The software will verify that the pressure is 50mmHg +/- 5mmHg, before it will begin a leak test.

6. Power down the unit and power the unit back up allowing it to boot up into its normal

mode.

7. Remove the clamp from the 250cc volume and place it on the 100cc volume. Select the “Inflation Test” option, and press the Test button. The unit will perform an inflation test. The inflation time is displayed in the “Timer” box. Verify that the inflation time meets the specification called out in the Repair Test Specification document.

8. Remove the clamp from the 500cc volume and place it on the 250cc volume. Select the “Dump Test” option, and press the Test button. The unit will perform a dump test. The dump time is displayed in the “Timer” box. Verify that the dump time meets the specification called out in the Repair Test Specification document.

9. Disconnect the test equipment pneumatic hose from the unit. Connect the large cuff with coiled tubing to the unit’s manifold. Wrap the large cuff around the 500cc volume, insuring that the white line, that runs along the end of the cuff, lines up with the “N” in the word “RANGE.” Select the Deflation Test option, and press the “TEST” button. The unit will do a normal blood pressure cycle and then display the step pressures in the “Valve Step Array Data” box. Verify that the step array data meets the specifications called out in the Repair Test Specification document.

   Click on Close when all tests have been completed.

5.7 Hardware Fail-safes

1. Connect the WELCH ALLYN MONITOR unit to the manual test station. Hook up the pressure lines to the coiled tubing of the monitor and the RS 232/Service port connector to the computer. Start the computer program by double clicking on its program icon.

2. Place the unit into the “Detailed Test” mode. Do this by holding the “start” and “cancel” button as the unit is powered up. Press the review button until “CAL” appears in the systolic window.

3. Select the ***Test|Hardware Fail-safes*** menu item.

4. Select the “Over Pressure” test, remove the cuff from the unit and attach the test station’s Pneumatic tubing to the unit. Press the Test button. Using the hand bulb, slowly increase the pressure, while observing the external pressure meter. The unit will return the hardware failsafe condition, E10. At this point, record the highest pressure observed on the external pressure meter. Verify that the over pressure value meets the specification called out in the Repair Test Specification document.

5. Select the Over 15mm Hg test, then press the Start Test button. Increase the pressure on the unit to above 15mm Hg, using the hand bulb. Once the pressure is above 15mm Hg the timer will start. As long as the units pressure remains above 15mm Hg the timer will keep increasing. If the unit drops below 15mm Hg the timer is reset. Verify that the pressure time out meets the specification called out in the Repair Test Specification document.

   This time is displayed in the “Timer” box.

6. Power down the unit, then power back up allowing the unit to go into it’s “normal” mode.

7. Select the Under 15mm Hg test, then press the Start Test button.

8. <u>*No user interaction required for this step*</u> : *The software will count down from 45 seconds before the unit is put into an auto cycle mode. Once in the auto-cycle mode the unit will start a cycle, which the software will then cancel. Once the system pressure drops below 15mm the timer will start again.*

9. Verify that the auto test meets the specification called out in the Repair Test Specification document in Section 7.

5.8 SpO_2 Tests

5.8.1 Nonin SpO_2

1. Connect the Nonin SpO_2 simulator to the unit with the test cable. The reading of the SpO_2 should be within the specified range indicated on the simulator.

2. Reconnect the SpO_2 sensor. Place the sensor onto your finger. The unit should return a reading if the sensor is OK.

5.8.2 Nellcor SpO_2

1. Connect the Nellcor SpO_2 simulator to the unit with the test cable. Make sure that the following settings* of the simulator are selected:

   Rate: 112
   Light: High 1
   Modulation: High
   RCAL Mode: RCAL63/Local

   Insure that the readings of the SpO_2 are within the specifications indicated on the simulator.

2. Reconnect the SpO_2 sensor. Place sensor onto your finger. The unit should return a reading if the sensor is OK.

*Note: On the Nellcor Simulator, if the settings are outside what is called out above, the alarms will activate on the monitor.

5.9 Temperature Tests

1. Disconnect the temperature probe from the unit leaving the probe itself in its housing. Place the “CAL key” into the connector. Remove the probe from the housing. The temperature should read the same as what is specified on the "cal" key. Remove the “cal” key and reconnect the probe. Place probe back into the housing.

2. Make sure that the unit’s temperature option is in the “monitor mode”. Do this by removing the probe from the housing and observing the temperature display. “Monitor mode” should be seen in the lower right hand side of the display. If this is not seen, wait approximately 30 - 45 seconds and the unit will change mode to the “monitor mode.”

3. Set up the Diatek 9600 calibrator. Set the calibrator to 96.4 F (35.8 C) or use a water bath between 84 F (28.8 C) and 106 F (41.1 C). Allow the calibrator to stabilize for three (3) minutes. Place the probe into the small hole in the calibrator. Observe the temperature display, The reading should be within the specified range, within 30 - 45 seconds.

4. Place the probe back into the housing. Set the calibrator to 106 F (41.1 C). Allow the calibrator to stabilize for three minutes. Remove the probe from the housing, the unit must be in the monitor mode, if not wait until the unit is in that mode. Place probe into the small hole at the top of the calibrator. The reading should be within the specified range, within 30 - 45 seconds. If using a water bath skip this part of the test.

5.10 Check List For Welch Allyn Vital Signs Monitor Service Work

General Data

Repair Number/RGA/RMA: _____
Service/Repair Date: _____
Test Technician Name: _____
Unit Serial Number: _____
Life Cycle Count: _____
Model Number: _____
Calibration: _____

Repair Data:

Check all items repaired/replaced and record serial # where possible:

- ☐ R1 - Main PCB
- ☐ R2 - Display PCB
- ☐ R3 - DC to DC Converter
- ☐ R4 - Transducer
- ☐ R5 - Temperature PCB
- ☐ R6 - Temp. Conn. PCB
- ☐ R7 - SpO_2 PCB (☐Nonin ☐Nellcor)
- ☐ R8 - Valve
- ☐ R9 - Pump
- ☐ R10 - Printer
- ☐ R11 - Switch Array
- ☐ R12 - Printer Flat Cable
- ☐ R13 - Manifold
- ☐ R14 - Pneumatic Tubing
- ☐ R15 - Main Wire Harness
- ☐ R16 - Pressure Switch
- ☐ R17 - Battery
- ☐ R18 - Front Housing
- ☐ R19 - Rear Housing
- ☐ R20 - Temperature Probe
- ☐ R21 - SpO_2 Probe
- ☐ R22 - Printer PCB
- ☐ R23 - Main Wire Harness
- ☐ R24 - Other: _____

Customer Complaint Codes:

- ☐ A1 - Will not take BP reading.
- ☐ A2 - Will not take SpO_2 reading.
- ☐ A3 - Will not take temperature reading.
- ☐ A4 - Will not print.
- ☐ A5 - Will not power up (turn on).
- ☐ A6 - LED's out.
- ☐ A7 - Housing Damaged (front)
- ☐ A8 - Housing Damaged (rear)
- ☐ A9 - Other: _____

Malfunction Codes: (Root Cause)

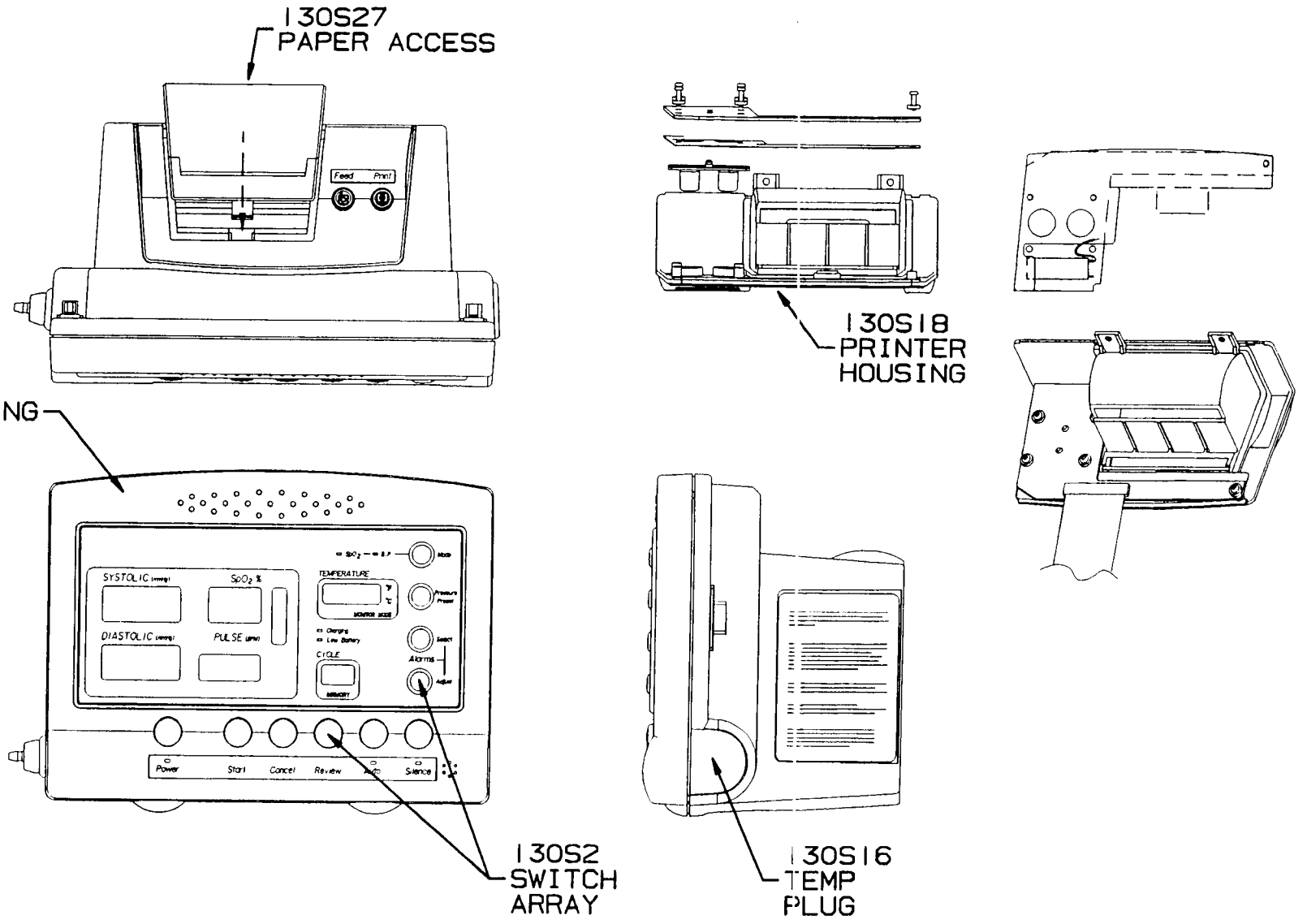
- ☐ 001 - Main PCB
- ☐ 002 - Temp. Connector
- ☐ 003 - Temp. Harness
- ☐ 004 - Printer
- ☐ 005 - Battery
- ☐ 006 - Temp. S/W bug
- ☐ 007 - Assembly Error
- ☐ 008 - Display PCB
- ☐ 009 - Printer PCB
- ☐ 010 - Printer Flat Cable
- ☐ 011 - Button Array
- ☐ 012 - Other Component
- ☐ 013 - Welch Allyn S/W bug
- ☐ 014 - Other
- ☐ 015 - SpO_2 PCB (☐Nonin ☐Nellcor)
- ☐ 016 - Main Harness
- ☐ 017 - Valve
- ☐ 018 - Pressure Switch
- ☐ 019 - Recover temp. error
- ☐ 020 - Test Equip. Prob.
- ☐ 021 - Temp. PCB
- ☐ 022 - SpO_2 Harness
- ☐ 023 - Pump
- ☐ 024 - DC to DC convert.
- ☐ 025 - SpO_2 S/W bug
- ☐ 026 - Bad Solder

Test Information:	_____	**Acceptable Ranges**
Unit software version	_____	(>1.69)
Temperature s/w ver.(If available)	_____	(>2.4)
SpO_2 software version(if available)	☐Nonin_____☐Nellcor_____	(Nonin:>5; Nellcor:>1.1.0.6)
Test pressure @ 0 mmHg	_____	(-0.3 to 0.3mmHg)
Unit pressure @ 0 mmHg	_____	(-0.75 to 0.75mmHg)
Test pressure @ 50 mmHg	_____	(45 to 55mmHg)
Unit pressure @ 50 mmHg	_____	(±1.5mmHg)
Test pressure @ 100 mmHg	_____	(95 to 105mmHg)
Unit pressure @ 100 mmHg	_____	(±1.5mmHg)
Test pressure @ 150 mmHg	_____	(145 to 155mmHg)
Unit pressure @ 150 mmHg	_____	(±1.5mmHg)
Test pressure @ 250 mmHg	_____	(245 to 255mmHg)
Unit pressure @ 250 mmHg	_____	(±1.5mmHg)
Test pressure @ 285 mmHg	_____	(290 to 280mmHg)
Unit pressure @ 285 mmHg	_____	(±1.5mmHg)
Test voltage 5.5 Vdc	_____	(5.5 to 6.0Vdc)
Unit voltage 5.5 Vdc	_____	(±0.05Vdc)
Blank mode current	_____	(≤80mA)
Idle mode current	_____	(≤800mA)
Valve current	_____	(≤140mA)
Pump current	_____	(≤550mA)
SpO_2 current (if available)	☐Nonin_____☐Nellcor_____	(Nonin:≤80mA; Nellcor:≤120mA)
Temperature current (if available)	_____	(≤15mA)
Noise level	_____	(≤0.05mmHg)
Button test	_____	(Pass/Fail)
Print quality (if available)	_____	(Pass/Fail)
Unit leak @ 250 mmHg(245/255 mmHg)	_____	(≤5mmHg)
Unit leak @ 50 mmHg (45/55 mmHg)	_____	(≤5mmHg)
Inflation Time	_____	(≤7 seconds)
Dump time	_____	(≤10 seconds)
Deflation Test	_____	(Pass/Fail)
Over pressure value	_____	(296 to 329mmHg)
Over 15mm Hg	_____	(155 to 180 seconds)
Under 15mm Hg	_____	(Pass/Fail)
SpO_2 sim. reading(if available)	☐Nonin_____☐Nellcor_____	(Nonin:98%,80BPM; Nellcor:81%,112BPM)
SpO_2 sensor reading(if available)	☐Nonin_____☐Nellcor_____	(Pass/Fail)
Temp. “Cal-key” read(if available)	_____	(97.3±0.2˚F, 36.3±0.1˚C)
Temp. calibrator read(if available)	_____	(96.1˚F to 96.7˚F) (35.6˚C to 36.0˚C)
Temp. calibrator read(if available)	_____	(105.7˚F to 106.3˚F) (40.9˚C to 41.3˚C)

For test data specifications consult the Repair Test Specification Document.

SECTION 6:

A) Drawings
B) Schematics
C) Board Layouts
D) Bill of Materials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ARRAY
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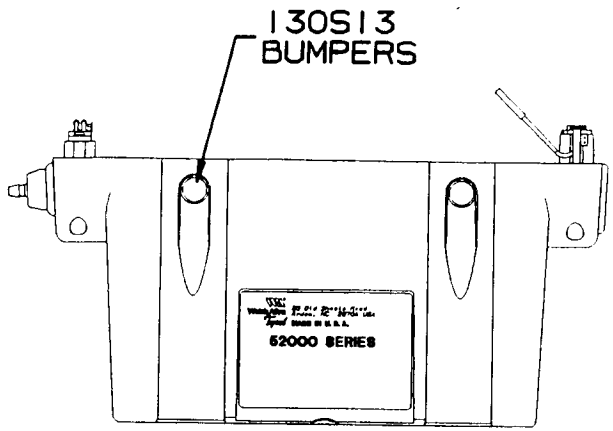
PLUG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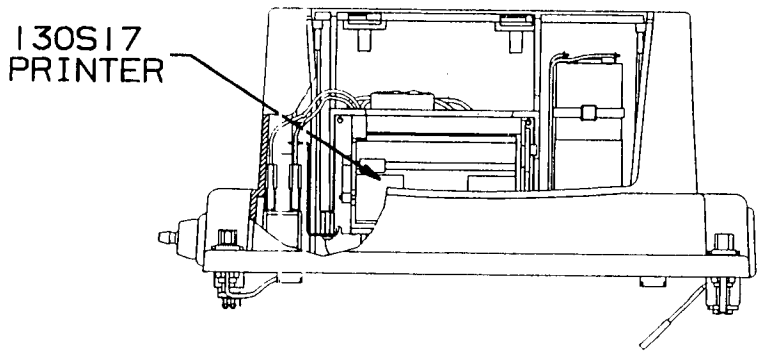
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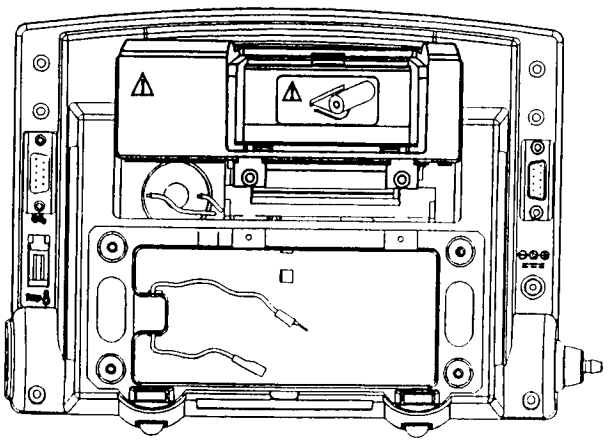
PRINTER



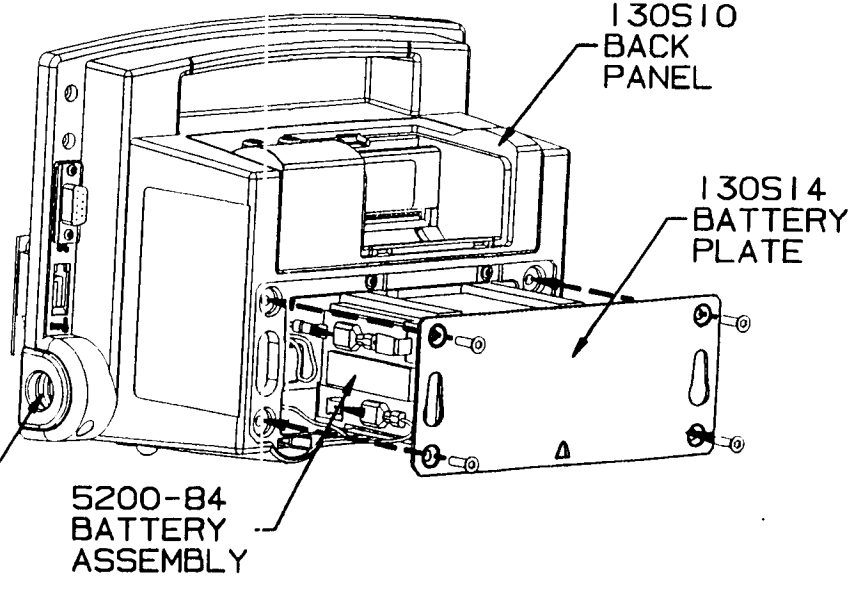

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PLATE
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TEMP
PROBE
HOUSING
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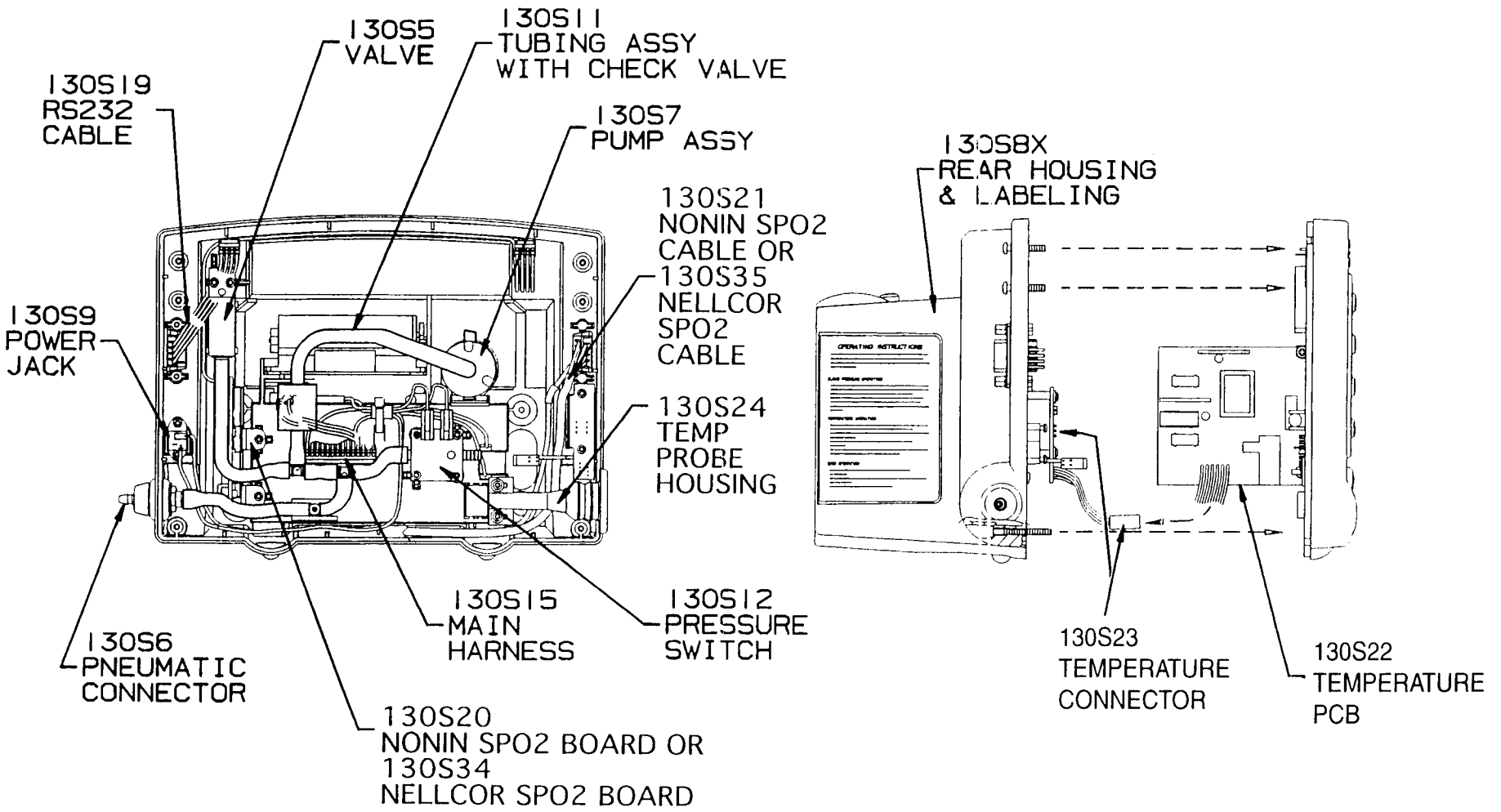
BATTERY
ASSEMBLY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VALVE
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TUBING ASSY
WITH CHECK VALVE
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RS232
CABLE
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PUMP ASSY
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REAR HOUSING
& LABELING
130S21
NONIN SPO2
CABLE OR
130S35
NELLCOR
SPO2
CABLE
130S9
POWER
JACK
130S24
TEMP
PROBE
HOUSING
130S15
MAIN
HARNESS
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PRESSURE
SWITCH
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PNEUMATIC
CONNECTOR
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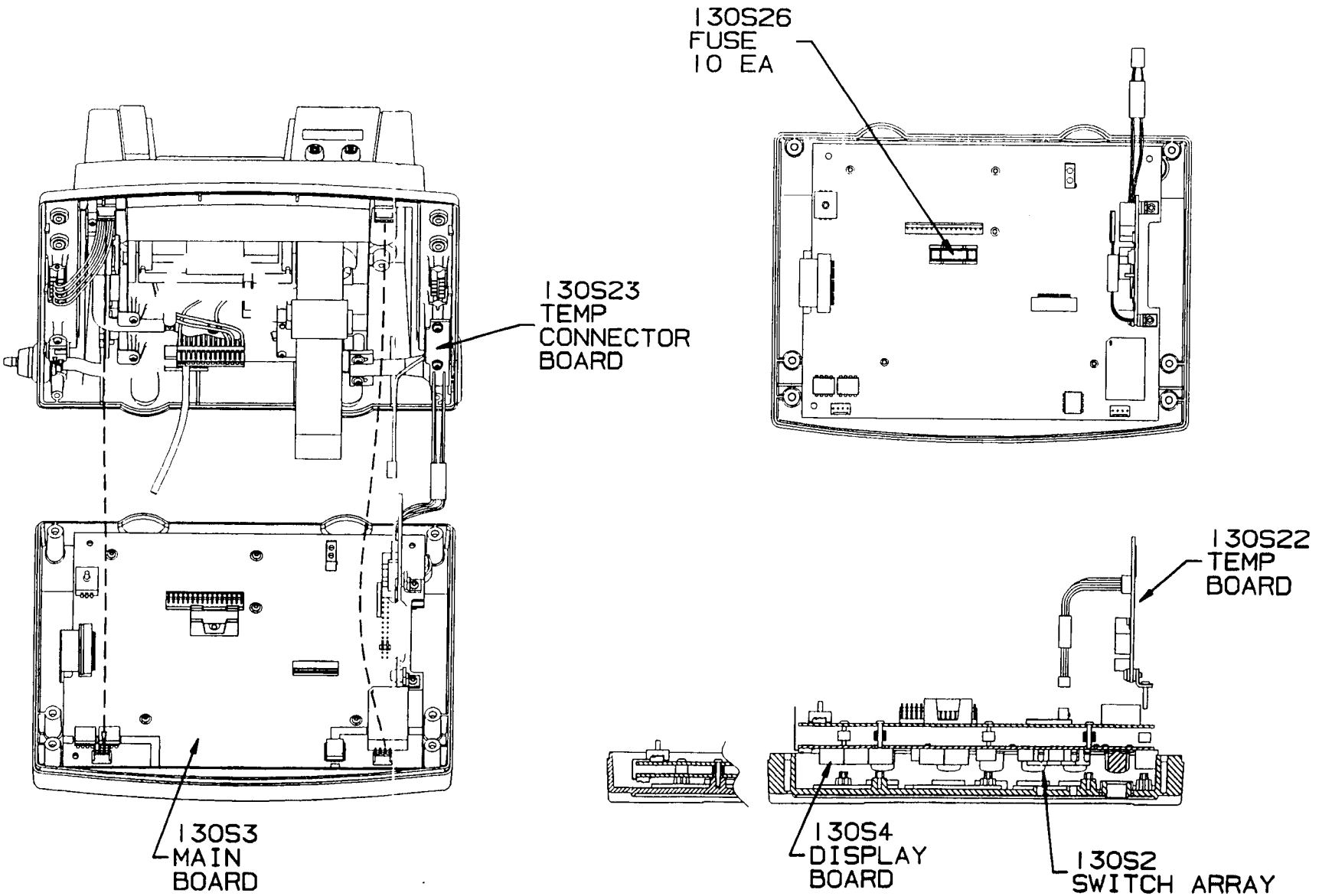
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TEMP
BOARD
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MAIN
BOARD
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DISPLAY
BOARD
130S2
SWITCH ARRAY

Due to the proprietary nature of the SpO2 PCBs of Nonin and Nellcor, the schematics, board layouts and bills of material could not be placed into this service manual. Please contact Nonin or Nellcor directly for this information.

Thanks!

Item	Qty	Reference	Value	Part / Alternates	Decal

THIS PAGE NOT USED --- SEE SHEET 1 OF DRAWING

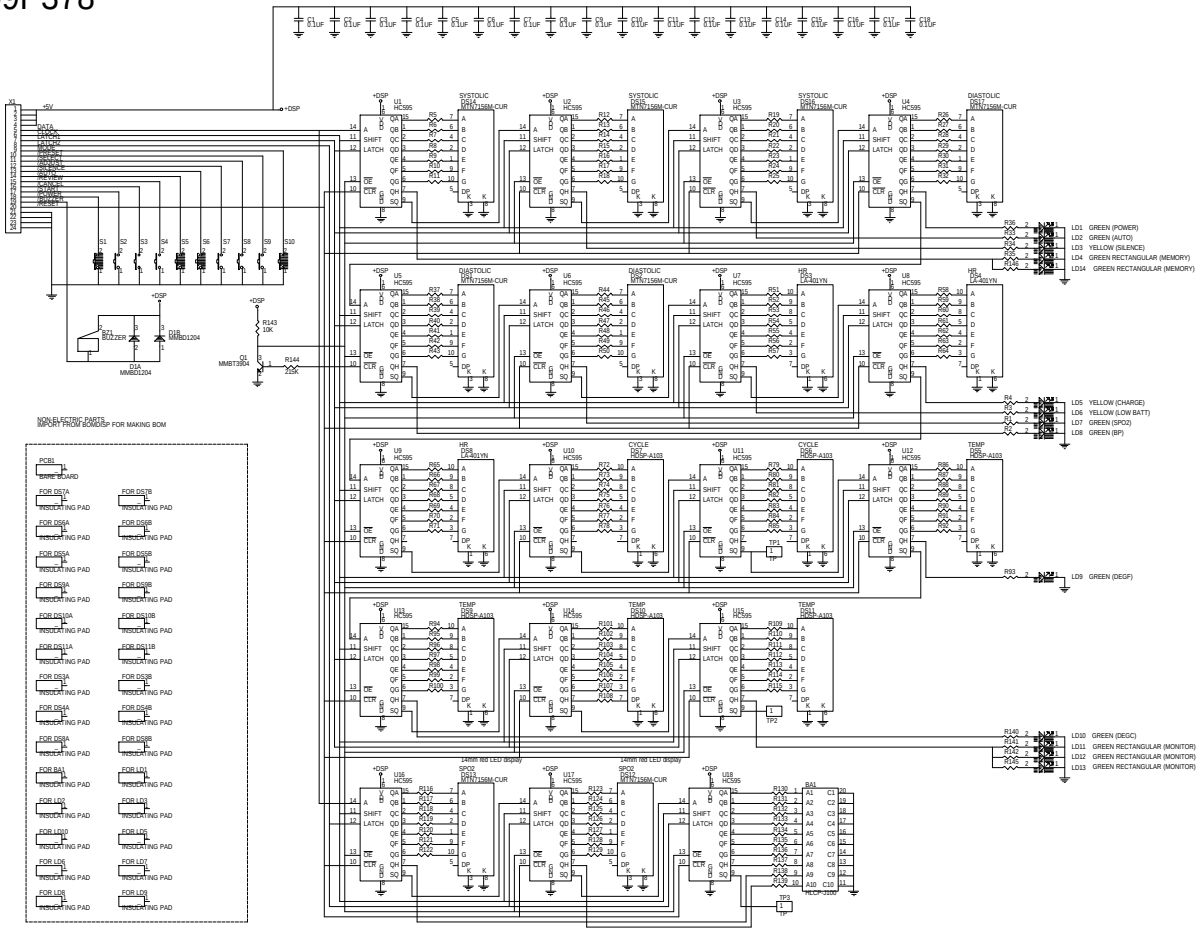
Item	Qty	Reference		Value	Part / Alternates	Decal
1	25	C1,C2,C3,C4,C5,C6,C7, C8,C 9,C10,C11,C12,C13, C14,C17,C18,C26,C29, C31,C32, C36,C37,C38, C40,C53	A	0.1UF CERAMIC Z5U	VITRAMON VJ0805U104MXAMT	SMD805
2	2	C15,C16	A	10PF CERAMIC NP0	AVX 08051A100KATMA	SMD805
3	3	C19,C25,C44	A	33UF 16V TANTALUM	AVX TAJD336M016R	SMDTC2
4	3	C20,C22,C23	A	100UF TANTALUM 6.3V	AVX TAJD107K006R	SMDTC2
5	5	C21,C39,C43,C46,C47	A	0.01UF CERAMIC X7R	AVX 08055C103KATMA	SMD805
6	3	C24,C42,C45	A	1000PF CERAMIC X7R	AVX 08055C102KATMA	SMD805
7	3	C27,C41,C49	A	4.7UF TANTALUM 10V	AVX TAJB475M010R	SMD3528
8	1	C28	A	100PF CERAMIC NPO	AVX 08055A101KATMA	SMD805
9	1	C30	A	10UF 25V TANTALUM	AVX TAJD106M025R	SMDTC2
10	1	C33	A	4700PF CERAMIC NP0	AVX 12101A472JATMA	SMD1210
11	1	C34	A	1500PF CERAMIC NP0	AVX 12061A152JATMA	SMD1206
12	1	C35	A	0.033UF CERAMIC X7R	AVX 08055C333JATMA	SMD805
13	1	C48	A	1UF TANTALUM 16V	AVX TAJA105K016R	SMDTCA
14	3	C50,C51,C52	A	10UF TANTALUM 10V	AVX TAJC106K010R	SMTTC1
15	4	D1,D2,D5,D7	A	MMBD1204 DUAL DIODE	NATIONAL MMBD1204	WAC_SOT-23_3
16	1	D3	A	10MQ090 SCHOTTKY RECTIFIER	IR 10MQ090, 10MQ100	D-64
17	1	D4	A	DL4003 RECTIFIER	DIODES INC DL4003TR	DL-41
18	1	D6	A	5.1V ZENER DIODE	MOTOROLA MMBZ5231BL	WAC_SOT-23_3
19	1	D8	A	LM385M VOLTAGE REFERENCE	NATIONAL LM385M	SO8
20	1	FOR F1	A	FUSE HOLDER	SCHURTER OGN031.8201	DUMMY
21	2	FOR PHO2-1,-2	A	SPACER	BIVAR ELM3-200	DUMMY
22	1	FOR Y1	A	SPACER	BIVAR CI-192-028	DUMMY
23	1	F1	A	FUSE 5A	SCHURTER SPT001.2511	CM113
24	1	ISO1	-	DC-DC CONVERTER	POWER CONVERTABLE PWR1300A	CM093
25	3	ISO2,ISO3,ISO	A	HCNW139 OPTOCOUPLER	HP HCNW139	CM086
27	7	J2,J4,J6,J8,J9,J10,J12	-	JUMPER	DO-NOT-INSTALL THRU-HOLE 0.1" SPACING	JUMP100
28	2	J5,J11	A	ZERO OHM RESISTOR	KOA RM73Z2AT	SMD805
29	2	J13,J14	-	ZERO OHM RESISTOR	KOA RM73Z2AT	SMD805

Item	Qty	Reference		Value	Part / Alternates	Decal
30	1	L1	A	220UH INDUCTOR	DELEVAN DVN 1812-224KT	SMD1812
31	1	N1	-	NODE	NOT-A-PART	SMDNODE
32	1	PCB1	A	BARE BOARD		DUMMY
33	1	PHO1	-	PHOTOSENSOR	ROHM RPR-363A	CM206
34	1	PHO2	A	PHOTOINTERRUPTER	OPTEK OPB810L51	CM302
35	2	P1,P2	-	NOT-A-PART		DUMMY
36	2	Q1,Q10	A	2N7002 NMOS	SILICONIX 2N7002	WAC_SOT-23_3
37	7	Q2,Q3,Q6,Q7, Q9,Q17,Q18	A	MMBT3904 NPN	MOTOROLA MMBT3904LT1	WAC_SOT-23_3
38	2	Q4,Q5	A	SI9955DY DUAL NPN	SILICONIX SI9955DY	SO8
39	1	Q11	A	TRANSISTOR NMOS	MOTOROLA MMBF0201NLT1	WAC_SOT-23_3
40	1	Q15	-	TP0610T PMOS	SILICONIX TP0610T	WAC_SOT-23_3
41	1	Q16	-	SI9955DY DUAL NPN	SILICONIX SI9955DY	SO8
42	1	RN1	A	100K 1/10W 1%	CTS 766-141104GTR07	SO14
43	2	R1,R26	A	9.09K 1/10W 1%	KOA RK73H2AT9091F	SMD805
44	6	R2,R34,R37,R52, R61,R80	A	1K 1/10W 1%	KOA RK73H2AT1001F	SMD805
45	4	R3,R5,R18,R72	A	12.1K 1/10W 1%	KOA RK73H2AT1212F	SMD805
46	9	R4,R10,R13,R14,R19, R23,R44,R66,R82	A	10K 1/10W 1%	KOA RK73H2AT1002F	SMD805
47	2	R6,R16	A	38.3K 1/10W 1%	KOA RK73H2AT3832F	SMD805
48	1	R7	A	5.11K 1/10W 1%	KOA RK73H2AT5111F	SMD805
49	7	R8,R9,R11,R12,R51, R68,R86	A	1M 1/10W 1%	KOA RK73H2AT1004F	SMD805
50	1	R15	A	26.1K 1/10W 1%	KOA RK73H2AT2612F	SMD805
51	13	R17,R22,R32,R46,R47, R54,R55,R56,R60,R76, R77,R85,R88	A	100K 1/10W 1%	KOA RK73H2AT1003F	SMD805
52	1	R20	A	215 1/10W 1%	KOA RK73H2AT2150F	SMD805
53	3	R21,R65,R67	A	100 1/10W 1%	KOA RK73H2AT1000F	SMD805
54	1	R24	-	INF	DO-NOT-INSTALL	SMD805
55	1	R25	A	162K 1/10W 1%	KOA RK73H2AT1623F	SMD805
56	3	R27,R33,R38	A	2.15K 1/10W 1%	KOA RK73H2AT2151F	SMD805
57	2	R28,R78	A	909 1/10W 1%	KOA RK73H2AT9090F	SMD805
58	1	R29	A	196 1/10W 1%	KOA RK73H2AT1960F	SMD805
59	3	R30,R31,R53	A	316K 1/10W 1%	KOA RK73H2AT3163F	SMD805

Item	Qty	Reference		Value	Part / Alternates	Decal
60	2	R35,R70	A	3.16K 1/10W 1%	KOA RK73H2AT3161F	SMD805
61	1	R36	A	68.1K 1/10W 1%	KOA RK73H2AT6812F	SMD805
62	2	R39,R40	A	82.5K 1/10W 1%	KOA RK73H2AT8252F	SMD805
63	1	R41	A	2.61K 1/10W 1%	KOA RK73H2AT2611F SEI RMC/10 1% 2.61	SMD805
64	3	R42,R45,R69	A	17.8K 1/10W 1%	KOA RK73H2AT1782F	SMD805
65	1	R43	A	56.2K 1/10W 1%	KOA RK73H2AT5622F	SMD805
66	1	R48	A	110K 1/10W 1%	KOA RK73H2AT1103F	SMD805
67	1	R49	A	261K 1/10W 1%	KOA RK73H2AT2613F	SMD805
68	1	R50	A	619 1/10W 1%	KOA RK73H2AT6190F	SMD805
69	1	R57	A	31.6K 1/10W 1%	KOA RK73H2AT3162F	SMD805
70	1	R62	A	4.64K 1/10W 1%	KOA RK73H2AT4641F	SMD805
71	1	R63	A	121K 1/10W 1%	KOA RK73H2AT1213F	SMD805
72	1	R64	A	383K 1/10W 1%	KOA RK73H2AT3833F	SMD805
73	1	R71	A	13.3K 1/10W 1%	KOA RK73H2AT1332F	SMD805
74	1	R73	A	7.5K 1/10W 1%	KOA RK73H2AT7501F	SMD805
75	1	R74	A	51.1K 1/10W 1%	KOA RK73H2AT5112F	SMD805
76	1	R79	A	110 1/10W 1%	KOA RK73H2AT1100F	SMD805
77	1	R81	A	237 1/10W 1%	KOA RK73H2AT2370F	SMD805
78	1	R83	-	INF DO-NOT-INSTALL	DO-NOT-INSTALL	SMD805
79	1	R84	A	31.6 1/10W 1%	KOA RK73H2AT31R6F	SMD805
80	1	R87	A	46.4K 1/10W 1%	KOA RK73H2AT4642F	SMD805
81	2	R89,R90	-	100 1/10W 1%	KOA RK73H2AT1000F	SMD805
82	25	TP1,2,3,4,5,6,7,8,9,10, 11,12,13,14,15,16,17, 18,19,20,21,22,23,24,25	-	TP	NOT-A-PART	TP40
83	1	U1	A	Z180FP MICROPROCESSOR	ZILOG Z8018008FSC	FP-80B
84	1	U2	A	29F010 FLASH PROM 128K*8	AMD 29F010-120JC	PLCC32
85	1	U3	A	TC55257 STATIC RAM 8K*8	TOSHIBA TC55257DFL-85L	SO28W
86	1	U4	A	DS1232 WATCHDOG/RESET	DALLAS DS1232LPS-2	SO8
87	1	U5	A	93C46 EEPROM 1KBIT	NATIONAL NM93C46AM8	SO8
88	1	U6	A	74HC32 QUAD OR GATE	MOTOROLA MC74HC32AD	SO14
89	1	U7	A	74HC138 3-8 DECODER	MOTOROLA MC74HC138AD	SO16
90	1	U8	A	82C54 TRIPLE TIMER	INTEL N82C54-2	PLCC28
91	1	U9	A	DS1284 REAL TIME CLOCK	DALLAS DS1284Q	PLCC28

Item	Qty	Reference		Value	Part / Alternates	Decal
92	3	U10,U11,U24	A	74HC259 8BIT ADDRESSABLE LATCH	MOTOROLA MC74HC259D	SO16
93	1	U12	A	4013 DUAL D-FF	MOTOROLA MC14013BD	SO14
94	1	U13	A	74HC139 DUAL 2-4 DECODER	MOTOROLA MC74HC139AD	SO16
95	2	U14,U15	A	4060 OSC/DIVIDER	MOTOROLA MC14060BD	SO16
96	3	U16,U17,U19	A	74HC00 QUAD NAND	MOTOROLA MC74HC00AD	SO14
97	3	U18,U20,U22	A	74HC74 DUAL D-FF	MOTOROLA MC74HC74AD	SO14
98	1	U21	A	74HC02 QUAD NOR	MOTOROLA MC74HC02AD	SO14
99	2	U23,U25	A	74HC251 8-CH DATA SELECTOR	MOTOROLA MC74HC251D	SO16
100	3	U26,U27,U32	A	LT1129 REGULATOR	LINEAR TECH LT1129CT FLOW 06	TO220-5A
101	1	U28	A	LM2941 REGULATOR	NATIONAL LM2941CT	TO220-5A
102	2	U29,U33	A	NE5234 QUAD OP-AMP	PHILIPS NE5234D	SO14
103	1	U30	A	4051 8-CH ANALOG MUX	MOTOROLA MC14051BD	SO16
104	1	U31	A	555 TIMER	MOTOROLA MC1455D	SO8
105	1	U34	A	DS1267 DUAL DIGITAL POT 100K	DALLAS DS1267S-100	SO16W
106	1	U35	A	LM334 TEMP SENSOR	LINEAR TECH LM334S8 NATIONAL LM334SM	SO8
107	1	U36	A	LM2931	NATIONAL LM2931AM-5.0	SO8
108	1	U37	A	MAX861 CHARGE PUMP 50MA	MAXIM MAX861CSA	S08
109	1	U38	A	74HC126 QUAD TRISTATE BUFFER	MOTOROLA MC74HC126AD	SO14
110	1	U39	A	PC16550 UART	NATIONAL PC16550DVEF	M_QFP44
111	1	XD1	A	SX05GD2 PRESSURE XDUCER	SENSYM SX05GD2	CM214
112	1	X1	A	HDR14 HEADER	AMP 1-640454-4	CM212
113	1	X2	A	HDR7 HEADER	AMP 640454-7	CM303
114	1	X3	A	HDR4 HEADER	AMP 640454-4	CM105
115	1	X4	A	HEADER18 HEADER	MOLEX 52207-1890	CM098
116	1	X5	A	HEADER24 HEADER	MOLEX 52207-2490	CM141
117	1	X7	A	HDR2 HEADER	MOLEX 22-28-4020	JUMP100
118	1	X8	A	HDR7 HEADER 7-PIN	AMP 641215-7	CM215
119	1	Y1	A	12.288MHZ CRYSTAL	FOX FOXS/128	XTAL200
120	1	Y2	A	32.768KHZ CRYSTAL	SEIKO DS-VT-200 OR DALLAS DS9032 OR DAIWA/KDS DT-38 OR FOX NC26	FX-3_H

109P378



REVISIONS:

1. AMT40863-10 INTRODUCE
2. AMT40863-15 CHANGE BP1 BACK TO STAR MICRONICS TMB-05
3. AMT40863-20 CHANGE LD2,3 FROM ELM2-280 TO ELM2-265
   CHANGE LD4,6,7 FROM ELM2-135 TO ELM4-135
4. AMT40863-49 CHANGE BUZZER FROM ELM4-135 TO ELM2-110

WELCH ALLYN / TYCOS INSTRUMENTS		
Title	SCHEMATIC, DISPLAY BOARD, CVSM	
Size: D	Document Number: 109P378 AMT40863-49	REV: 4
Date: June 4, 1999	Sheet: of 1	

CVSM DISPLAY BOARD
125S208A AMT40863-49
Bill Of Materials

Revised: June 4, 1996
Schematic Revision: 4

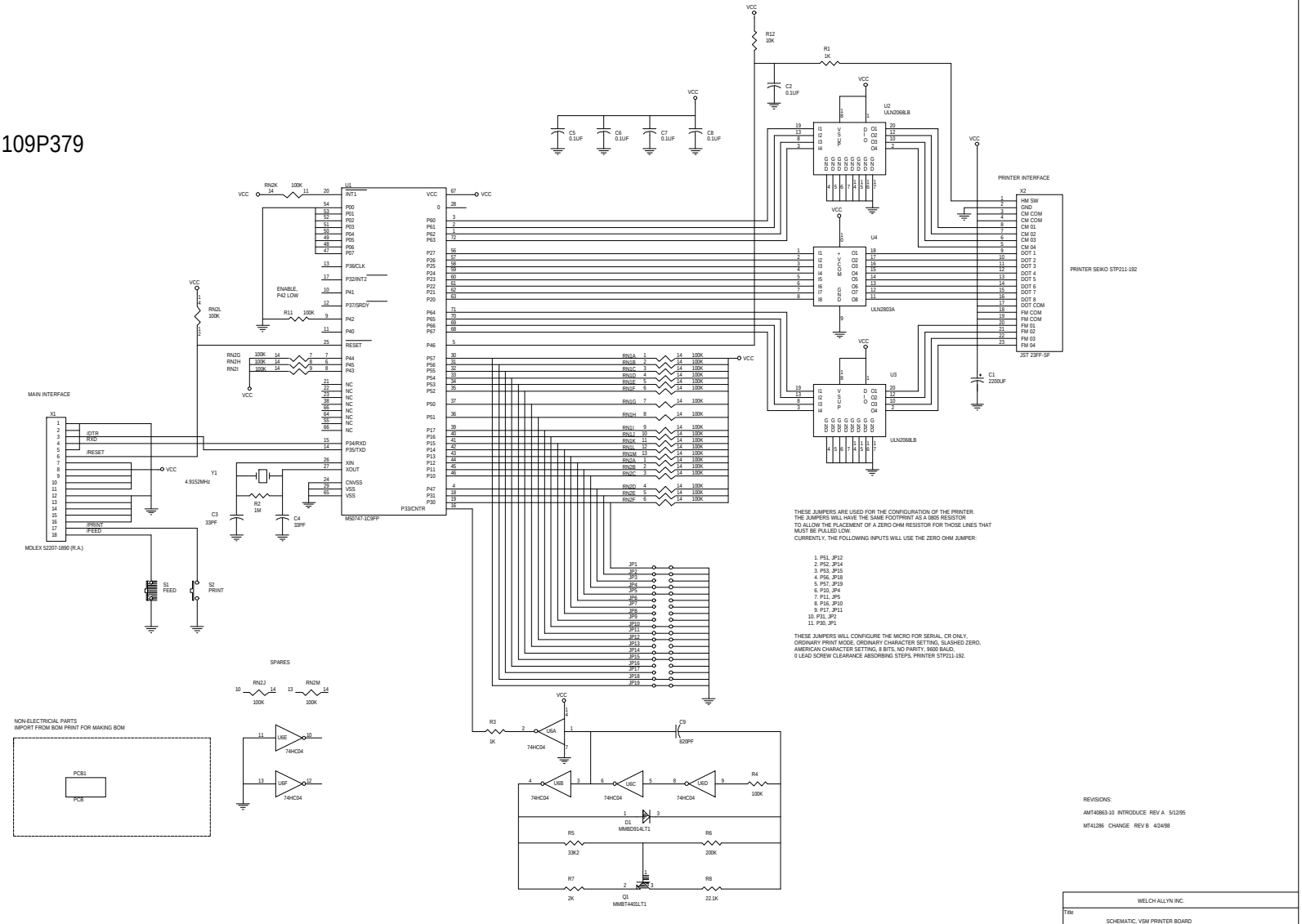
ITEM	QTY	REFERENCE	CONFIG	VALUE/DESCRIPTION	MFG/MFG #	ALTERNATES	DECAL
1	1	BA1	A	HLCP-J100 10-bargraph	HP HLCP-J100		CM059
2	1	BZ1	A	BUZZER	STAR MICRONICS TMB-05		CM063
3	18	C1,C2,C3,C4,C5,C6,C7,C8, C9,C10,C11,C12,C13,C14, C15,C16,C17,C18	A	0.1UF Ceramic Z5U	T&B/VITRAMON VJ0805U104MXAMT		SMD805
4	8	DS1,DS2,DS12,DS13,DS14, DS15,DS16,DS17	A	MTN7156M-CUR 14mm red LED display	MARKTECH MTN7156M-CUR		CM003
5	3	DS3,DS4,DS8	A	LA-401YN 10mm yellow LED display	ROHM LA-401YN		CM002
6	6	DS5,DS6,DS7,DS9,DS10, DS11	A	HDSP-A103 7mm red LED display	HP HDSP-A103		CM021
7	1	D1	A	MMBD1204 Dual diode	NATIONAL MMBD1204		WAC_SOT-23_3
8	1	FOR BA1	A	INSULATING PAD	BIVAR 816-080		
9	6	FOR DS3B,FOR DS3A, FOR DS4B,FOR DS4A, FOR DS8B,FOR DS8A	A	INSULATING PAD	BIVAR 366-300		
10	12	FOR DS5B,FOR DS5A, FOR DS6B,FOR DS6A, FOR DS7B,FOR DS7A, FOR DS9B,FOR DS9A, FOR DS10B,FOR DS10A, FOR DS11B,FOR DS11A	A	INSULATING PAD	BIVAR 388-075		
11	3	FOR LD1,FOR LD2,FOR LD3	A	INSULATING PAD	BIVAR ELM2-265		
12	6	FOR LD5,FOR LD6,FOR LD7, FOR LD8,FOR LD9,FOR LD10	A	INSULATING PAD	BIVAR ELM2-110		
13	1	LD1	A	GREEN (POWER)	ROHM SLR-37MC3F		CM060
14	1	LD2	A	GREEN (AUTO)	ROHM SLR-37MC3F		CM060
15	1	LD3	A	YELLOW (SILENCE)	ROHM SLR-37YC3F		CM132
16	2	LD4,LD14	A	GREEN RECTANGULAR (MEMORY)	HP HLMP-0504		CM204
17	1	LD5	A	YELLOW (CHARGE)	ROHM SLR-37YC3F		CM132
18	1	LD6	A	YELLOW (LOW BATT)	ROHM SLR-37YC3F		CM132
19	1	LD7	A	GREEN (SPO2) SPO2 OPTION	ROHM SLR-37MC3F		CM060
20	1	LD8	A	GREEN (BP) SPO2 OPTION	ROHM SLR-37MC3F		CM060
21	1	LD9	A	GREEN (DEGF) SPO2 OPTION	ROHM SLR-37MC3F		CM060
22	1	LD10	A	GREEN (DEGC) TEMP. OPTION	ROHM SLR-37MC3F		CM060
23	2	LD11,LD12	A	GREEN RECTANGULAR (MONITOR) TEMP. OPTION	HP HLMP-0504		CM204
24	1	LD13	-	GREEN RECTANGULAR (MONITOR) TEMP. OPTION	HP HLMP-0504		CM204
26	1	Q1	A	MMBT3904 NPN	MOTOROLA MMBT3904LT1		WAC_SOT-23_3

CVSM DISPLAY BOARD
125S208A AMT40863-49
Bill Of Materials

Revised: June 4, 1996
Schematic Revision: 4

27	80	R1,R2,R3,R4,R5,R6,R7,R8, R9,R10,R11,R12,R13,R14, R15,R16,R17,R18,R19,R20, R21,R22,R23,R24,R25,R26, R27,R28,R29,R30,R31,R32, R33,R34,R35,R36,R37,R38, R39,R40,R41,R42,R43,R44, R45,R46,R47,R48,R49,R50, R93,R116,R117,R118,R119, R120,R121,R122,R123,R124, R125,R126,R127,R128,R129, R130,R131,R132,R133,R134, R135,R136,R137,R138,R139, R140,R141,R142,R145,R146	A	681 1/10W 1%	KOA RK73H2AT6810F	SMD805
28	21	R51,R52,R53,R54,R55,R56, R57,R58,R59,R60,R61,R62, R63,R64,R65,R66,R67,R68, R69,R70,R71	A	316 SMD805	KOA RK73H2AT3160F	SMD805
29	43	R72,R73,R74,R75,R76,R77, R78,R79,R80,R81,R82,R83, R84,R85,R86,R87,R88,R89, R90,R91,R92,R94,R95,R96, R97,R98,R99,R100,R101, R102,R103,R104,R105,R106, R107,R108,R109,R110,R111, R112,R113,R114,R115	A	1K21 1/10W 1%	KOA RK73H2AT1211F	SMD805
30	1	R143	A	10K 1/10W 1%	KOA RK73H2AT1002F	SMD805
31	1	R144	A	215K 1/10W 1%	KOA RK73H2AT2153F	SMD805
32	10	S1,S2,S3,S4,S5,S6,S7,S8, S9,S10	-	SWPB	NOT-A-PART	SW-CONTACT
33	3	TP1,TP2,TP3	-	TP	NOT-A-PART	TP40
34	18	U1,U2,U3,U4,U5,U6,U7,U8, U9,U10,U11,U12,U13,U14, U15,U16,U17,U18	A	HC595 8-bit shift reg w/ hold reg	MOTOROLA MC74HC595AD	SO16
35	1	X1	A	HEADER24 Header	MOLEX 52207-2490	CM141

109P379



REVISIONS:

AMT40863-10 INTRODUCE REV A 5/12/95

MT41286 CHANGE REV B 4/24/98

WELCH ALLYN INC.		
Title: SCHEMATIC, VSM PRINTER BOARD		
Size: C	Document Number: 109P379	REV: B
Date: April 29, 1998	Sheet 1 of 1	

VSM PRINTER BOARD — Schematic Revised: April 24, 1998

125S209A Bill Of Materials **MT41286** — Drawing Revision: B

ITEM	QTY	REFERENCE	CONFIG	VALUE/DESCRIPTION	MFG/MFG #	ALTERNATES	DECAL
1	1	C1	A	2200UF Electrolytic	Panasonic EEU-FA1A222		CM159
2	5	C2,C5,C6, C7,C8	A	0.1UF Ceramic Z5U	T&B/VITRAMON VJ0805U104MXAMT		SMD805
3	2	C3,C4	A	33PF Ceramic NP0	AVX/KYOCERA 08055A330KATMA		SMD805
4	1	C9	A	820PF Ceramic X7R	AVX/KYOCERA 08051C821KATMA		SMD805
5	1	D1	A	MMBD914LT1 Diode	MOTOROLA MMBD914LT1		WAC_SOT-23_3
6	11	JP1,JP2,JP4, JP5,JP10,JP11 JP12,JP14,JP15 JP18,JP19	A	JUMP1	JUMP805		SMD805
7	8	JP3,JP6,JP7, JP8,JP9,JP13, JP16,JP17	-	JUMP0	NOT-A-PART		SMD805
9	1	Q1	A	MMBT4401LT1 NPN	MOTOROLA MMBT4401LT1		WAC_SOT-23_3
10	2	RN2,RN1	A	100K	CTS 766-141104GTR07		SO14
11	2	R3,R1	A	1K 1/10W 1%	KOA RK73H2AT1001F		SMD805
12	1	R2	A	1M 1/10W 1%	KOA RK73H2AT1004F		SMD805
13	2	R4,R11	A	100K 1/10W 1%	KOA RK73H2AT1003F		SMD805
14	1	R5	A	33K2 1/10W 1%	KOA RK73H2AT3322F		SMD805
15	1	R6	A	200K 1/10W 1%	KOA RK73H2AT2003F		SMD805
16	1	R7	A	2K 1/10W 1%	KOA RK73H2AT2001F		SMD805
17	1	R8	A	22.1K 1/10W 1%	KOA RK73H2AT2212		SMD805
18	1	R12	A	10K 1/10W 1%	KOA RK73H2AT1002F		SMD805
19	1	S1	-	FEED	NOT-A-PART		SW-CONTACT
20	1	S2	-	PRINT	NOT-A-PART		SW-CONTACT
21	1	U1	A	M50747-1C9FP Microcontroller	SEIKO/MITSUBISHI M50747-1C9FP		QFP-72
22	2	U3,U2	A	ULN2068LB Quad driver	ALLEGRO ULN2068LB		SO20W
23	1	U4	A	ULN2803A Octal driver	ALLEGRO ULN2803A	MOTOROLA ULN2803A	DIP18
24	1	U6	A	74HC04 Hex inverter	HARRIS CD74HC04M		SO14
25	1	X1	A	MOLEX 52207-1890 (R.A.) Header-18	MOLEX 52207-1890		CM098
26	1	X2	A	JST 23FF-SF Header-23	JST 23FF-SF		CM095
27	1	Y1	A	4.9152MHz Crystal	ECS ECS-49-20-4		XTAL200

REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED
A	Initial Release	11/17/95	
B	ADDED J1-C,J1-H,J2,C14, and replaced R30 with Amb. Thrm.	1/10/96	2725

3 AA ALKALINE BATTERIES 3.0 - 5.0 V

B1-1 B1-2 VCC

Q12 BSS138 Q13 BSS138

A/D OUT LOW BAT

J3 13PIN

R24 47k PROBE SW

R15 47k R31 47k

RTS CTS TXD RXD CAL

J2

R12 47k RECTAL PROBE

R25 47k AXILLARY PROBE

R11 100k R13 100k B J1-B J1-E

PROBE CONNECTOR

CUT HERE FOR RECTAL P1-B OR P1-E HERE FOR AXILLARY

R9 10M X2 XTAL 32KHz C6 33pF C4 33pF

R7 100k C1 0.1uF D6 XX459

X1 4MHz CERRES

U2 M38203M4

R27 100k A/D PWR A/D OUT

U1 MONOCHIP DGND AGND C9 47uF C11 0.01uF C12 0.01uF

R26 3.01M 1% R29 2M C2 1uF Film C3 0.01uF E1 L2 10uH

Q11 MM2222 C13 330pF

A/DTRIGGER

R8 12.1k 0.1% R5 10.0k 0.1% R3 13.7k 0.1% R28 270k D9 XX459

Q6 BSS138 Q5 BSS138 Q4 BSS138 E2 E3 E4

BATT AD SELECT LO CAL SELECT HI CAL SELECT PTB CAL TEST SELECT PROBE SELECT SERSITIN

Ambient Thermistor J1-H J1-G E5 Q14 BSS138 C14 1000pF

Probe Thermistor J1-C J1-A

C10 1000 pF Q10 BSS138

U3 93LC56

R18 1k Q7 BCX69 HTRQ HTRPWR HTRRST

D7 XX459 R22 470k R16 470 Q9 BCX69 R20 47k R23 47k

C8 1uF Q8 MM5087 R21 4.7k C7 0.01uF L1 10uH J1-D J1-F PROBE HEATER

uP HEATER CONTROL (ACTIVE LOW)

Q Top Views

NOTES (UNLESS OTHERWISE SPECIFIED):

1 All resistors values are in Ohms and are +/-5%.

2 Analog and Digital grounds are connected here during routing.

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	APPROVAL	DATE
CHECK		1-11-96
PROJ. MGR.		1/12/96
QA		1/12/96
MFG. ENG.		1-12-96
REL. AUTH.		1-12-96

FILE: 10200#B.SCH

DIATEK

SCHEMATIC, 675 OEM

Size (c) B | Number 55102-0000 | Revision B

Date: 10-Jan-1996 | Sheet of | of 1

File: C:\WP\DATA\SCHMATIC\10200#B.SCH | Drawn By: MJR

SECTION 7:

Repair Test Specifications

Repair Test Specifications

Clinical Vital Signs Monitor

Original Date: March 29, 1996

Current Revision Date: July 13, 1998

File: 126P175C.DOC

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Note 1: The word “Unit” throughout this document refers to the CBP unit with out pneumatics (tubing and cuff), temperature probe, SpO_2 probe, and main battery attached,
unless other wise noted.

Note 2: All test are performed in the “Detailed Test Mode” or in the “Normal Mode” unless other wise noted.

Note 3: Standard test voltage unless otherwise stated is 6.5 (+/- 0.25) Vdc.

Note 4: All test are performed utilizing the CVSM Repair Software.

Note 5: Unless otherwise stated, all calibrated volumes will be +/- 10cc of the stated volume.

Note 6: Unit software will be equal to or greater than “1.69.” If the monitor has Nonin SpO_2, the Nonin SpO_2 software will be equal to or greater than “5.” If the unit has Nellcor SpO_2, the Nellcor SpO_2 software will be equal to or greater than “1.1.0.6.” If the monitor has temperature, temperature software will be equal to or greater than “2.4.”

REPAIR TESTS

Leak Tests

1. Unit must not leak more than 5 mmHg in a 15 second interval while attached to a 100cc calibrated volume and pressurized to between 245 and 255 mmHg.

2. Unit must not leak more than 5 mmHg in a 15 second interval while attached to a 100cc calibrated volume and pressurized to between 45 and 55 mmHg.

Inflation Test

3. Unit must be able to inflate a 250.0cc (+ 50.0cc/- 0cc) calibrated volume from less than 5.0 mmHg to greater than 210.0 mmHg in 7.0 seconds or less.

Dump Test

4. Unit must be able to deflate a 500.0cc (+ 100.0cc/- 0cc) calibrated volume from greater than 260.0 mmHg to less than 15.0 mmHg in 10 seconds or less.

Unit Manometer Calibration

5. Internal temperature of the unit must be less than 32 degrees Celsius before performing calibration. Prior to calibration the zero and gain must be set to 128. Prior to calibration the three pressure connection valves must be set to 16384. The zero pot will be adjusted to produce a minimum error (± 1 count) when 0(± 0.3) mmHg is applied. The count written to the pot must be between 5 and 250. The unit must successfully perform a autozero after this zero pot adjustment. The unit gain will then be calibrated for minimum error value (± 0.5 mmHg) when a pressure between 195 mmHg and 205 mmHg is applied. The unit pressure reading will then be adjusted at a pressure between 90 mmHg and 100 mmHg to within ± 0.5 mmHg of the applied pressure. The unit pressure reading will then be adjusted at a pressure between 190 mmHg and 200 mmHg to within ± 0.5 mmHg of the applied pressure. The unit pressure reading will then be adjusted at a pressure between 280 mmHg and 290 mmHg to within ± 0.5 mmHg of the applied pressure. The Pressure Correction Values written to the unit must be between 16384 ± 1000. Calibration information stored in the unit to include above constants, calibration date and time (local standard date and time), and a four character calibrator's identification signature (the calibrator's three initials and a "*". The "*" will be automatically placed into the signature by the CVSM repair software).

Manometer Accuracy Test

6. Internal temperature of the unit must be less than 32.0 degrees Celsius before performing test. The unit manometer reading must be within +/- 0.75 mmHg of the applied pressure of 0 mmHg +/- 0.3 mmHg. The units manometer must be within +/- 1.5 mmHg of the applied test pressure of 50 mmHg +/- 5 mmHg. The units manometer must be within +/- 1.5 mmHg of the applied test pressure of 100 mmHg +/- 5 mmHg. The units manometer must be within +/- 1.5 mmHg of the applied test pressure of 150 mmHg +/- 5 mmHg. The units manometer must be within +/- 1.5 mmHg of the applied test pressure of 250 mmHg +/- 5 mmHg. The units manometer must be within +/- 1.5 mmHg of the applied test pressure of 285 mmHg +/- 5 mmHg.

Deflation Test

7. With the unit connected to a large cuff and a target inflation pressure of 200 mmHg, have the unit perform a complete "normal" BP cycle. There are no requirements for step size for the steps after the pump has stopped (Note: Steps zero and one are dummy steps = 0.0 mmHg and are ignored). For steps two and three, the size of the step must be between 3.0 mmHg and 11.0 mmHg. Step four and all other steps above or equal to 40 mmHg, must be between 7.0 mmHg and 11.0 mmHg. All steps below 40 mmHg except for the last step will be between 4.5 mmHg and 10 mmHg. The last step will be between 0.01 mmHg and 10 mmHg.

Voltage and Current Testing

8. The unit battery voltage reading must be calibrated to within +/- 0.05 Vdc at a nominal calibrated battery voltage input of 5.5 Vdc +0.5,-0.0 Vdc. Calibration should include a verification test at this specified test point. A four character calibration signature will be written to unit upon satisfactory calibration completion (the calibrator's three initials and a "*". The "*" will be automatically placed into the signature by the CVSM repair software).

9. Unit "Blank" mode current must less than or equal to 80.0 mA. "Blank" mode current is determined when all LED segments are off, SpO_2 mode is off, and the Temperature board is asleep.

10. Unit "Idle" mode current must be less than or equal to 800 mA. "Idle" mode current is determined when all LED segments are on, SpO_2 mode is off and the Temperature board is asleep.

11. Unit "Valve" mode current must be less than or equal to 140 mA. "Valve" mode current is determined by placing the unit into the "Blank" mode, actuating the valve on, recording the current then subtracting the "Blank" mode current for test current.

12. Unit "Pump" mode current must be less than or equal to 550 mA. "Pump" mode current is determined by unit into "Blank" mode, actuating the valve on, operating the pump on, recording the current then subtracting the "Valve" mode current from the test current.

13. Internal electrical noise of the unit's pressure channel determined by using serial 1 second noise sample command must be less than or equal to 0.05 mmHg.

Hardware Fail-safe Tests

14. "Over pressure test": Units hardware must detect over pressure on unit pneumatic system between 296.0 mmHg and 329.0 mmHg.

15. "Over 15 mmHg test": Unit hardware must detect if the pneumatic system has been pressurized greater than 15 mmHg for more than 155 second but less than 180 seconds.

16. "Under 15 mmHg test": With the unit in the non_stat automatic mode (timed automatic blood pressure cycle), the unit's hardware will not allow an automatic cycle if the pressure has been less than 15mmHg for less than 25 seconds. The unit's hardware must allow an automatic cycle if the pressure has been less than 15mmHg for more than 35 seconds.

SpO_2 Option Testing (Nonin)

17. Note: setting for this test are specific to the “Nonin Patient Simulator” model 8000S. Accuracy of the SpO_2 board after 25 second stabilization period must be within +/- 2% O_2 and +/- 2 BPM. Values are 98% O_2 and 80 BPM.

18. Unit “SpO_2” mode current must be less than or equal to 80.0 mA. “SpO_2” mode current is determined by turning off all the LEDs, putting the Temperature board asleep, actuating the SpO_2 and waiting 25 second for stabilization, recording currnt then subtracting “Blank” mode current from the test current.

SpO_2 Option Testing (Nellcor)

19. Note: Settings for this test are specific to the “Nellcor Patient Simulator” model SRC2. Accuracy of the Nellcor SpO_2 board after 25 second stabilization period must be within +/- 3% O2 and +/- 2 BPM. Values are 81% O2 and 112 BPM.

20. Unit “SpO_2” mode current must be less than or equal to 120 mA. “SpO_2” mode current is determined by turning off all LEDs, putting the Temperature board asleep, actuating the SpO_2 and waiting 25 seconds for stabilization, reording current the subtracting “Blank” mode current from the test current.

Temperature Option Testing

21. The accuracy of the Temperature board must be within +/- 0.1 degree F for readings with a nominal temperature of 97.3 degrees F (36.3 C $\pm$ .1 C) (Using the CAL Key)

22. The unit must be able to read a temperature of 96.4 degrees F (35.8 C) and a temperature of
106 degrees F (41.1 C) within +/- 0.3 degrees F (using Diatek 9600 Calibrator to obtain
temperatures). Note: if using a water bath to take temperature reading, the temperature of the bath should be between 84 (28.8 C)and 106 (41.1 C)degrees F and the reading must be within +/- 1.0 degrees F measure against a temperature standard that is accurate to +/- 1 degree F.

23. Unit “Temperature” mode current must be less than or equal to 15.0 mA. “Temperature” mode current is determined by turning off all LEDs, turning SpO2 mode off, actuating the Temperature board, waiting 5 seconds, recording current then subtracting “Blank” mode current from test current.

Printer Option Testing

24. The printer must be able to print out test pattern 1 and test pattern 2 (small and large ASCII characters (test 1) gray solid field (test 2)). The technician will subjectively determine if the print quality is sufficient.

RS232 Testing

25. The RS232 communication operation will be confirmed with successful serial transmit and receive.